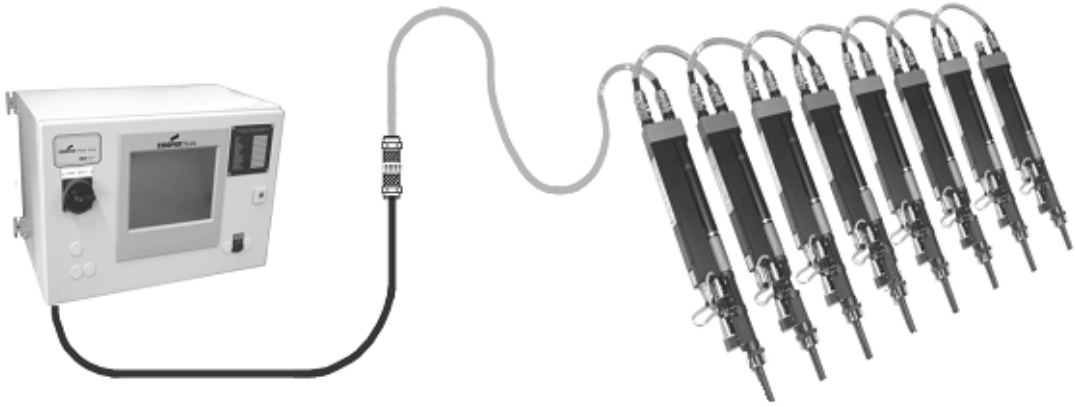
System handbook
P1917E/EN
2011-05

m-Pro-400S-DGD-Intelligent-Spindle

Series BTS



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About this system handbook

This is the – translation of the original system handbook – and

- provides important information on safe, correct and efficient operation of the system.
- describes the function and operation of the components.
- serves as a lexicon for technical data.
- It points out options.

Secondary information

P1792E	Operator information Nutsetter control unit m-Pro-400S
P1909E	Spare parts sheet Tightening module
P1910E, P1911E, P1912E	Spare parts sheet Attachment
P1913E	Spare parts sheet Gearing
P1914E	Spare parts sheet Motor
P1915E	Spare parts sheet Transducer
P1916E	Assembly instructions DGD-IS built-in nutsetter
P1918E	Assembly instructions TS/TUS tightening module
P1919E	Assembly instructions Supply module CPS3
P1921E	Service manual DGD-intelligent-spindle

Symbols in text

➔	Identifies instructions to be followed.
•	Identifies lists.
italics	Indicates menu items such as *Diagnostics* in software descriptions
<…>	Identifies elements that have to be selected or deselected, such as buttons or control boxes, e.g. <F5>
Courier	Indicates the name of paths and files, e.g. **`setup.exe`**
\	A backslash between two names indicates the selection of an item from the menu, e.g. file \ print

Abbreviations

m-Pro-400S	Station controller
m-Pro-400S-CPM…	Nutsetter control unit
TS/TUS	Tightening module
CPS3	Supply module
DGD-IS	DGD intelligent spindles

Symbols in graphics:

⟵	Identifies movement in a direction.
⇩	Identifies function and force.

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1 Safety

1.1 Warnings and notes

DANGER!

A symbol combined with the word **DANGER** warns of an **impending health risk** or risk of fatal injury to personnel. If this danger note is not adhered to, severest injury that may lead to the death of people, is the consequence.

WARNING!

A symbol combined with the word **WARNING** warns of a **potentially dangerous** situation for the health of personnel, which could result in death or serious injury if not avoided.

CAUTION!

A symbol combined with the word **CAUTION** warns of a **potentially harmful** situation for the health of personnel or damage to property or the environment. If this warning is not observed, injuries, property or environmental damage may occur.

NOTE

This symbol indicates a **general** instruction.
General instructions include application tips and special useful information, but no warnings against dangers.

1.2 Basic requirements for safe working practices

Take the fastening system into service only after you have read and completely understood the following safety instructions and this document. Failure to observe the instructions below may result in electric shock, fire and serious injuries.

DANGER!

High leakage current –
Fatal electric shock could occur!

- ➔ Always disconnect the power supply before performing maintenance work on the DGD-IS and the m-Pro-400S-CPM….
- ➔ Always disconnect the system cable, motor or motor cable from the m-Pro-400S-CPM… or DGD-IS before making throughput, resistance and short circuit measurements.
- ➔ Do not attempt to repair possible faults on the fastening system by yourself if you do not have the required knowledge! Inform the local repair center or your Sales & Service Center.

WARNING!

High temperature –
the motor on the DGD-IS may heat up and cause burns during removal.
(max. engine temperature 90 °C). Wear gloves.

CAUTION!

Risk of flying parts.
Components of the spindle may rotate, come loose and cause injury.
Avoid speed increases of over 3 m/s² on all axes.

CAUTION! Work area

- ➔ Close all safety devices.
- ➔ Ensure that there is enough space in the work area.
- ➔ Keep the work area clean.

Electrical safety

- ➔ Do not operate the fastening system outdoors.
- ➔ Observe the safety notes on the DGD-IS.

Safe working with and around fastening tools

- ➔ Inspect screw bits and retaining ring for visible damage and cracks. Replace damaged parts immediately.
- ➔ Always disconnect the power supply to the DGD-IS before changing screw bits.
- ➔ Only use screw bits for machine-controlled fastening tools.
- ➔ Make sure that the screw bits are retained securely.

➔ We do not claim that these safety notes are complete. Read and observe all applicable, general and local safety and accident prevention rules.

➔ Follow a safety-conscious maintenance program which takes into account the local regulations for maintenance and servicing in all phases of operation of the fastening electronics.

1.3 Operator training

- The fastening system may only be operated by personnel that have been trained and instructed correspondingly and authorized by the operator.
- The fastening system may only be maintained and serviced by personnel instructed by qualified staff from DGD.
- The operator must make sure that all new operating and maintenance personnel are instructed in the operation and maintenance of the fastening system to the same extent and with the same care and attention.
- Personnel who are being trained may work on the fastening system only under the supervision of an experienced operator.

1.4 Personal protective equipment

When working

- Wear the protective goggles to protect against spurting metal splinters.

Danger of injury by being wrapped up in and caught by machinery

- Wear close-fitting clothing.
- Do not wear jewelry.

1.5 Intended use

The owner is responsible for using the machine according to its designated use.
The fastening system may be used only under the following conditions:

- Do not operate the fastening system outdoors.
- Industrial environment EMC limit class value A, DIN EN 550081-2.
- The DGD-IS is designed for stationary operation only and is intended exclusively for fastening and loosening thread connections. Do not use as a hand-held tool.
- Always use the DGD-IS in combination with the nutsetter control unit m-Pro-400S-CPM….
- The DGD-IS must be fully assembled. Insert and lock all connecting cables.
- Secure the DGD-IS to an electroconductive, grounded mounting plate.
- Always use the DGD-IS in combination with the control unit m-Pro-400S-CPM….
- Only cable types approved by DGD may be used.
- Only accessory parts approved by DGD may be used.
- Unauthorized alterations, repairs and modifications are prohibited for reasons of safety and product liability.
- Do not operate the fastening system outdoors.

NOTE

- ➔ Always remove the complete DGD-IS from a unit.
- ➔ Do not open the transducer, offset attachment or angle head attachment as this will void the warranty. A repair is only permitted by DGD authorized personnel. If repair is required, send the complete component to Sales & Service Center.
- ➔ Do not open the TS/TUS or CPS3 as this will void the warranty.
  This does not include the service panel. A repair is only permitted by DGD authorized personnel. If repair is required, send the complete component to Sales & Service Center.
- ➔ Read the following documents when replacing the DGD-IS
  - this system manual (see 16 Maintenance / Service, Seite 83)
  - the DGD intelligent spindle assembly instructions
  - Service manual DGD-IS
  - Spare part sheets

1.6 Ambient conditions

Do not operate the fastening system in an explosive atmosphere.

System components	Ambient temperature	Relative humidity	Working height
DGD-IS	32 to 113 °F (0 to 45 °C)	0 to 90 % no condensation	up to 3000 m above sea level
m-Pro-400S-CPM…			
TS/TUS			
Motor			
CPS3	32 to 158 °F (0 to 70 °C)		

1.7 EMC

- The tool complies with the following applicable EMC standards:
  - DIN EN 61000-3-2
  - DIN EN 61000-3-3
  - DIN EN 61000-6-2
  - DIN EN 61000-6-4

- The filters required to fulfill the EMC standards are integrated in the system components.
- Shielded cables offer protection against irradiating and radiating interference.
- All cable shields are connected to the shield terminals on the nutsetter control unit and the plug casing on the DGD-IS.

NOTE

Equipment from EMC limit class value A, DIN EN 55 0081-2.
This equipment may cause radio interference in residential areas. Should this occur, you may request that the operator pay for and implement relevant EMC measures.

1.8 Noise

DGD-IS	dB(A)
1B(U)TS-1B012A-…	72
1B(U)TS-1B035A-…	72
1B(U)TS-1B060A-…	67
2B(U)TS-2B110A-…	71
2B(U)TS-2B200A-…	67
3B(U)TS-3B300A-…	66
4B(U)TS-4B500A-…	66
4B(U)TS-4B660A-…	66

Measured sound pressure level at idling speed (no load) / clockwise rotation in accordance with ISO 3744.

2 Transport / Storage

- Transport only in the original packing.
- If the package is damaged, check the part for visible damage.
  Inform the carrier or Sales & Service Center, if necessary.

WARNING!

Sharp cooling fins on the m-Pro-400S-CPM… may cause cutting injuries.

➔ Wear gloves when transporting and assembling the machine.

System components	Storage temperature	Relative humidity
DGD-IS	-20 to 70 °C	0 to 90 % no condensation
m-Pro-400S-CPM…	-20 to 70 °C	0 to 90 % no condensation
TS/TUS	-20 to 70 °C	0 to 90 % no condensation
Motor	-20 to 70 °C	0 to 90 % no condensation
CPS3	-25 to 70 °C	0 to 90 % no condensation

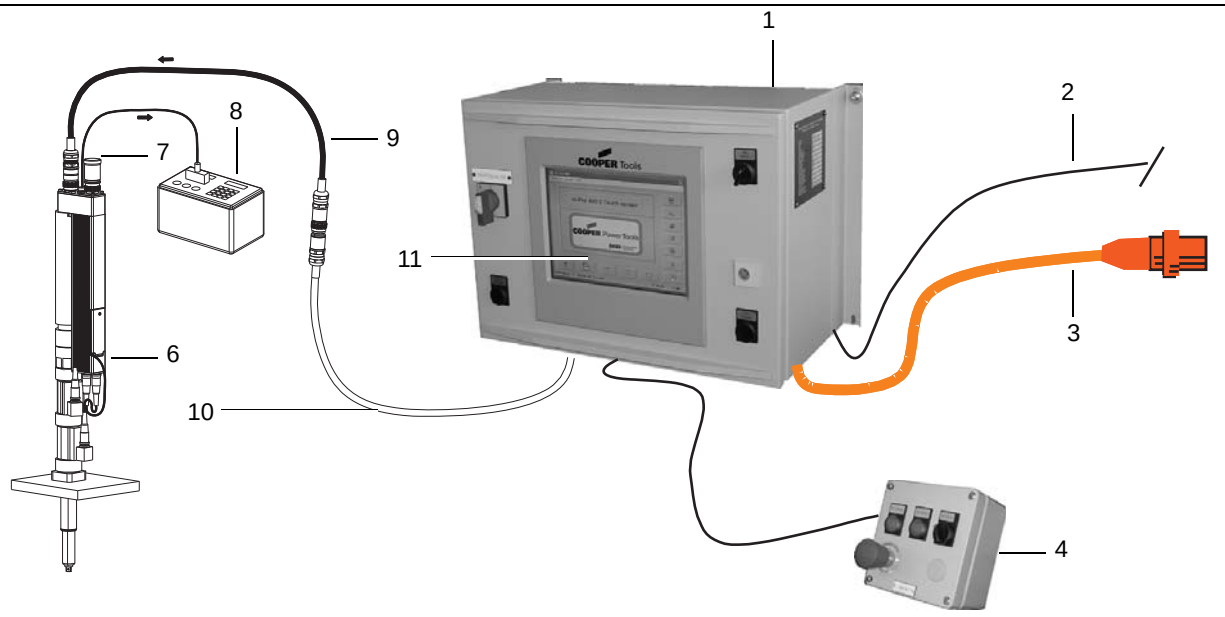
3 System description

The system design is determined by the size and quantity of DGD-IS used and always varies depending on the individual situation. These components can be combined with one another in various sizes.
This chapter includes a brief description of the components. Each respective chapter contains separate technical details.

Special features of the fastening system m-Pro-400S-DGD-Intelligent-Spindle

In the m-Pro-400S-DGD-Intelligent-Spindle fastening system, the tightening modules are no longer installed in a control cabinet, but directly on the built-in nutsetter, see system "m-Pro-400-tm" with single cable solution.
The intermediate circuit voltage was increased from 320 VDC to 380 VDC compared to the "TM" tightening modules. This increased the maximum speed of the built-in nutsetter by 20 %.

3.1 Components



Item	Designation
1	Nutsetter control unit m-Pro-400S-CPM…
2	Cable, machine control
3	Mains cable, 3×400 VAC
4	Operator panel with emergency stop button
6	DGD-IS
7	ARCNET terminator
8	Optional test case MPK
9	System cable, type A
10	System cable, type C
11	Station controller m-Pro-400S, touch screen

3.1.1 DGD-IS

The DGD-IS is available in sizes 1B(U)TS…, 2B(U)TS…, 3B(U)TS… and 4B(U)TS….
for a torque range of 2 to 1600 Nm.

3.1.2 Nutsetter control unit

Power and logic power supplied via the nutsetter control unit m-Pro-400S-CPM….

- Depending on the size and number, a maximum of 16 DGD-IS can be connected to a system cable (m-Pro-400S-CPM… to the last DGD-IS). If the number of channels is greater, the m-Pro-400S-CPM… is set up as a control cabinet.
- A maximum of 32 DGD-IS can be connected to one nutsetter control unit.

Available channel numbers

Code	Maximum number of DGD-IS				Number of system cables
	1B(U)TS…	2B(U)TS…	3B(U)TS…	4B(U)TS…	
m-Pro-400S-CPM3	16	6	6	6	1
m-Pro-400S-CPM6	32	12	12	12	2
m-Pro-400S-CPM9	–	18	18	18	3
Control cabinet	–	32	32	32	depending on version

The maximal numbers of DGD Intelligent Spindles per Controller depends on load.
When calculating the maximum number of spindles, please consider the following conditions:

- Maximum speed at 20% of maximum torque (at 1BTS, 2BTS, 3BTS and 4BTS)
- Final tightening stage up to 500 Nm Maximal Speed 50 rpm at maximum torque (at 1BTS, 2BTS, 3BTS and 4BTS-4B500A...)
- Final tightening stage over 500 Nm Maximal Speed 20 rpm at maximum torque (at 4BTS-4B660A..., 4BTS-4B660A-4VK4MS, 4BTS-4B360A-4Z1250A and 4BTS-4B460A-4Z1600A)

If higher settings are chosen, the number channels should be reduced.
If different spindle types are used at the controller, the number of channels will be individually defined.
Please contact your Sales & Service Center.

3.1.3 Cables

Maximum length 164 ft (50 m).
From m-Pro-400S-CPM… – to the last DGD-IS.

3.1.4 ARCNET

Communication to the m-Pro-400S-CPM… is achieved via the ARCNET serial high-performance field bus, based on RS485.

- ARCNET lines are integrated in the system cable between m-Pro-400S-CPM… – DGD-IS, and from DGD-IS to DGD-IS.
- Several system cable harnesses converge at the nutsetter control units m-Pro-400S-CPM6 and m-Pro-400S-CPM9. An ARCNET bus amplifier module (ARCNET HUB 1E3A order no. 961237) is installed for this purpose. The module allows a star-shaped bus topology.

4 Initial operation

When operating the machine for the first time, read and observe the system manual or the operator information for the m-Pro-400S(E).

1. Position the DGD-IS components together via flat toothed interfaces, see Service manual.
   Turn size 1 in 15° increments.
   Turn sizes 4 to 2 in 10° increments.
2. Connect all components, see 3.1 Components, Seite 9.

CAUTION!

Risk of tripping or falling over loose cables on the ground.
Lay all connected cables safely.

3. Close all plug connectors and lock.

NOTE

The red ring around the outer diameter of plug connectors with a slide lock should not be visible.

NOTE

Always terminate the ARCNET with an ARCNET terminator at the bus end, i.e. at the last DGD-IS, order no. 961127. This terminator is installed permanently in the nutsetter control unit m-Pro-400S-CPM… (bus start).

4. Connect the mains cable to the nutsetter control unit.

DANGER!

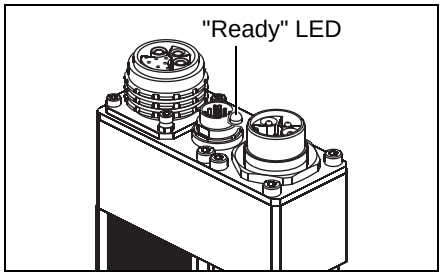
High leakage current – Fatal electric shock could occur.
Establish a grounding connection (PE) to the nutsetter control unit before taking into operation!

5. Preset the ARCNET address on each DGD-IS under the service panel,
   see 6.4.1 ARCNET address preset, Seite 30.

NOTE

Each address can be used only once in the system!

6. Close the service panel.
7. Close the protective devices (e.g. safety grilles).
8. Switch on the machine control unit (PLC/SPS).
9. Switch on the nutsetter control unit.
   If there are no faults pending after switching on the unit, the "Ready" LED on the DGD-IS lights up green.
   Otherwise see 15 Troubleshooting, Seite 69, Troubleshooting.



10. Enter the parameters for the torque / angle setting via the m-Pro-400S-CPM…
    DGD specialist staff are responsible for programming the m-Pro-400S-CPM… prior to initial operation. The first time the nutsetter control unit is switched on, the parameters for controlling fastening sequences must be read in via the keyboard or a valid parameter file. See m-Pro-400S operator information for details of nutsetter control unit process programming.

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5 DGD intelligent spindles

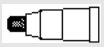
5.1 General technical data

- torque measurement with integrated pre-amplifier, resulting in greater signal noise spacing
- fault-resistant, magnetic field sensor angle measuring system
- reverse voltage protected supply
- short-circuit proof outputs
- low voltage monitor
- watchdog for processor
- noise-protected input and output circuit

Features	Data
Protection category	IP54
Service life, operating	40,000 h
Load cycles (min. at maximum torque)	1,000,000, then recalibration
Mechanical overload capacity of the measuring shaft	100 %

5.2 Catalogue data

5.2.1 Size 1 – 1× transducer

Designation	Order No.	Torque Nm		Speed	Spring travel		Min. axis distance	Length	Weight	Spring chuck	
		max.	min.	rpm	mm		mm	mm	kg		+ flange
1BTS-1B012A-1K3B-1ZB	947541A8	12	2	1921	50	3/8"	43	486	4.8	922325	S308434
1BTS-1B035A-1K1B-1ZB	947553A4	35	5	727							
1BTS-1B060A-1K2B-1ZB	947565A0	53	15	427							
1BTS-1B012A-1VK3B	947543A6	12	2	1825			35	474	5.3		S308437
1BTS-1B035A-1VK1B	947555A2	35	5	690							
1BTS-1B060A-1VK2B	947567A8	53	15	405							
1BTS-1B012A-1WK3B	947545A4	12	2	1801	25		52	542	5.7	–	929041
1BTS-1B035A-1WK1B	947557A0	35	5	681							
1BTS-1B060A-1WK2B	947569A6	53	15	400							
1BUTS-1B012A-1K3B-1ZB	947547A2	12	2	1921	50		43	393	5.3	922325	S308434
1BUTS-1B035A-1K1B-1ZB	947559A8	35	5	727							
1BUTS-1B060A-1K2B-1ZB	947571A2	53	15	427							
1BUTS-1B012A-1VK3B	947549A0	12	2	1825			35	382	5.8		S308437
1BUTS-1B035A-1VK1B	947561A4	35	5	690							
1BUTS-1B060A-1VK2B	947573A0	53	15	405							
1BUTS-1B012A-1WK3B	947551A6	12	2	1801	25		52	370	6.2	–	929041
1BUTS-1B035A-1WK1B	947563A2	35	5	681							
1BUTS-1B060A-1WK2B	947575A8	53	15	400							

Smallest scribed circle diameter in mm

Quantity	Attachment		
DGD-IS	Centric	Offset	Angle head
2	43	35	52
3	54	40	60
4	61	50	74
5	81	58	89
6	99	70	105
7	116	85	120

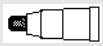
5.2.2 Size 1 – 2× transducer

Designation	Order No.	Torque Nm		Speed	Spring travel		min. axis dis-tance	Length	Weight	Spring Chuck	
		max.	min.	rpm	mm		mm	mm	kg		+ flange
1BTS-1B012A-2/1K3B-1ZB	947542A7	12	2	1921	50	3/8"	43	566	5.4	922325	S308434
1BTS-1B035A-2/1K1B-1ZB	947554A3	35	5	727							
1BTS-1B060A-2/1K2B-1ZB	947566A9	53	15	427							
1BTS-1B012A-1K3B-1VK3B	947544A5	12	2	1825			35	554	5.9		S308437
1BTS-1B035A-1K1B-1VK1B	947556A1	35	5	690							
1BTS-1B060A-1K2B-1VK2B	947568A7	53	15	405							
1BTS-1B012A-1K3B-1WK3B	947546A3	12	2	1801	25		52	622	6.3	–	929041
1BTS-1B035A-1K1B-1WK1B	947558A9	35	5	681							
1BTS-1B060A-1K2B-1WK2B	947570A3	53	15	400							
1BUTS-1B012A-2/1K3B-1ZB	947548A1	12	2	1921	50		43	393	5.9	922325	S308434
1BUTS-1B035A-2/1K1B-1ZB	947560A5	35	5	727							
1BUTS-1B060A-2/1K2B-1ZB	947572A1	53	15	427							
1BUTS-1B012A-1K3B-1VK3B	947550A7	12	2	1825			35	382	6.4		S308437
1BUTS-1B035A-1K1B-1VK1B	947562A3	35	5	690							
1BUTS-1B060A-1K2B-1VK2B	947574A9	53	15	405							
1BUTS-1B012A-1K3B-1WK3B	947552A5	12	2	1801	25		52	450	6.8	–	929041
1BUTS-1B035A-1K1B-1WK1B	947564A1	35	5	681							
1BUTS-1B060A-1K2B-1WK2B	947576A7	53	15	400							

Smallest scribed circle diameter in mm

Quantity	Attachment		
DGD-IS	Centric	Offset	Angle head
2	43	35	52
3	54	40	60
4	61	50	74
5	81	58	89
6	99	70	105
7	116	85	120

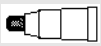
5.2.3 Size 2 – 1× transducer

Designation	Order No.	Torque Nm		Speed	Spring travel		min. axis dis-tance	Length	Weight	Spring Chuck	
		max.	min.	rpm	mm		mm	mm	kg		+ flange
2BTS-2B110A-2K1B-2ZB	947517A8	110	25	890	50	1/2"	56	528	7.6	910609	S308435
2BTS-2B200A-2K3B-2ZB	947529A4	200	40	502		3/4"					
2BTS-2B110A-2VK1B	947521A2	110	25	831		1/2"	44	551	9.2		S308438
2BTS-2B200A-2VK3B	947533A8	200	40	468		3/4"					
2BTS-2B110A-2WK1B	947525A8	110	25	838	25	1/2"	59	581	8.7	–	929053
2BTS-2B200A-2WK3B	947537A4	200	40	472		3/4"					
2BUTS-2B110A-2K1B-2ZB	947519A6	110	25	890	50	1/2"	56	367	8.6	910609	S308435
2BUTS-2B200A-2K3B-2ZB	947531A0	200	40	502		3/4"					
2BUTS-2B110A-2VK1B	947523A0	110	25	831		1/2"	44	390	10.2		S308438
2BUTS-2B200A-2VK3B	947535A6	200	40	468		3/4"					
2BUTS-2B110A-2WK1B	947527A6	110	25	838	25	1/2"	59	421	9.7	–	929053
2BUTS-2B200A-2WK3B	947539A2	200	40	472		3/4"					

Smallest scribed circle diameter in mm

Quantity	Attachment		
DGD-IS	Centric	Offset	Angle head
2	56	44	59
3	75	50	68
4	80	62	86
5	106	74	101
6	130	89	118
7	151	102	137

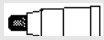
5.2.4 Size 2 – 2× transducer

Designation	Order No.	Torque Nm		Speed	Spring travel		min. axis dis-tance	Length	Weight	Spring Chuck	
		max.	min.	rpm	mm		mm	mm	kg		+ flange
2BTS-2B110A-2/2K1B-2ZB	947518A7	110	25	890	50	1/2"	56	625	8.7	910609	S308435
2BTS-2B200A-2/2K3B-2ZB	947530A1	200	40	502		3/4"					
2BTS-2B110A-2K1B-2VK1B	947522A1	110	25	831		1/2"	44	648	10.3		S308438
2BTS-2B200A-2K3B-2VK3B	947534A7	200	40	468		3/4"					
2BTS-2B110A-2K1B-2WK1B	947526A7	110	25	838	25	1/2"	59	678	9.8	–	929053
2BTS-2B200A-2K3B-2WK3B	947538A3	200	40	472		3/4"					
2BUTS-2B110A-2/2K1B-2ZB	947520A3	110	25	890	50	1/2"	56	464	9.7	910609	S308435
2BUTS-2B200A-2/2K3B-2ZB	947532A9	200	40	502		3/4"					
2BUTS-2B110A-2K1B-2VK1B	947524A9	110	25	831		1/2"	44	487	11.3		S308438
2BUTS-2B200A-2K3B-2VK3B	947536A5	200	40	468		3/4"					
2BUTS-2B110A-2K1B-2WK1B	947528A5	110	25	838	25	1/2"	59	518	10.8	–	929053
2BUTS-2B200A-2K3B-2WK3B	947540A9	200	40	472		3/4"					

Smallest scribed circle diameter in mm

Quantity	Attachment		
DGD-IS	Centric	Offset	Angle head
2	56	44	59
3	75	50	68
4	80	62	86
5	106	74	101
6	130	89	118
7	151	102	137

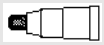
5.2.5 Size 3 – 1× transducer

Designation	Order No.	Torque Nm		Speed	Spring travel		min. axis distance	Length	Weight	Spring Chuck	
		max.	min.	rpm	mm		mm	mm	kg		+ flange
3BTS-3B300A-3K2B-3ZB	947577A6	300	50	453	50	3/4"	81	589	14.1	910613	S308436
3BTS-3B300A-3VK2B	947579A4			421			59	584	15.2		S308439
3BTS-3B300A-3WK2B	947581A0			437	25		81	678	17.8	–	929065
3BUTS-3B300A-3K2B-3ZB	947583A8			453	50			417	16.1	910613	S308436
3BUTS-3B300A-3VK2B	947585A6			421			59	412	17.2		S308439
3BUTS-3B300A-3WK2B	947587A4			437	25		81	506	19.8	–	929065

Smallest scribed circle diameter in mm

Quantity	Attachment		
DGD-IS	Centric	Offset	Angle head
2	81	59	81
3	94	69	94
4	116	84	116
5	139	102	139
6	164	122	164
7	189	138	189

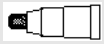
5.2.6 Size 3 – 2× transducer

Designation	Order No.	Torque Nm		Speed	Spring travel		min. axis distance	Length	Weight	Spring Chuck	
		max.	min.	rpm	mm		mm	mm	kg		+ flange
3BTS-3B300A-2/3K2B-3ZB	947578A5	300	50	453	50	3/4"	81	701	16.2	910613	S308436
3BTS-3B300A-3K2B-3VK2B	947580A1			421			59	696	17.3		S308439
3BTS-3B300A-3K2B-3WK2B	947582A9			437	25		81	790	19.9	–	929065
3BUTS-3B300A-2/3K2B-3ZB	947584A7			453	50			528	18.2	910613	S308436
3BUTS-3B300A-3K2B-3VK2B	947586A5			421			59	523	19.3		S308439
3BUTS-3B300A-3K2B-3WK2B	947588A3			437	25		81	617	21.9	–	929065

Smallest scribed circle diameter in mm

Quantity	Attachment		
DGD-IS	Centric	Offset	Angle head
2	81	59	81
3	94	69	94
4	116	84	116
5	139	102	139
6	164	122	164
7	189	138	189

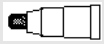
5.2.7 Size 4 – 1× transducer

Designation	Order No.	Torque Nm		Speed	Spring travel		min. axis distance	Length	Weight	Spring Chuck	
		max.	min.	rpm	mm		mm	mm	kg		+ flange
4BTS-4B500A-4K2B-4ZA	947589A2	500	100	254	50	3/4"	91	719	21	–	916643
4BTS-4B660A-4K3B-4ZA	947601A5	660	130	174		1"					916642
4BTS-4B360A-4K1B-4Z1250A	947617A7	1250	320	86		1"	121	771	29		S976956
4BTS-4B500A-4K2B-4Z1600A	947621A1	1600	400	68		1 1/2"					S308441
4BTS-4B500A-4VK2B	947591A8	500	100	238		3/4"	76	684	22.5	912106	S308440
4BTS-4B660A-4VK3B	947603A3	660	130	163		1"				912147	
4BTS-4B660A-4VK4B	947607A9	750	160	135		1"					
4BTS-4B500A-4WK2B	947593A6	500	100	245	25	3/4"	112	729	27.1	–	929077
4BTS-4B660A-4WK3B	947605A1	660	130	167		1"					929089
4BUTS-4B500A-4K2B-4ZA	947595A4	500	100	254	50	3/4"	91	546	22.5	–	916643
4BUTS-4B660A-4K3B-4ZA	947609A7	660	130	174		1"					916642
4BUTS-4B360A-4K1B-4Z1250A	947619A5	1250	320	86		1"	121	599	31		S976956
4BUTS-4B500A-4K2B-4Z1600A	947623A9	1600	400	68		1 1/2"					S308441
4BUTS-4B500A-4VK2B	947597A2	500	100	238		3/4"	76	512	24	912106	S308440
4BUTS-4B660A-4VK3B	947611A3	660	130	163		1"				912147	
4BUTS-4B660A-4VK4B	947615A9	750	160	135		1"			24.5		
4BUTS-4B500A-4WK2B	947599A0	500	100	245	25	3/4"	112	556	28.6	–	929077
4BUTS-4B660A-4WK3B	947613A1	660	130	167		1"			28.7		929089

Smallest scribed circle diameter in mm

Quantity	Attachment		
DGD-IS	Centric	Offset	Angle head
2	91	76	112
3	122	88	130
4	130	108	160
5	174	130	192
6	217	153	224
7	246	180	263

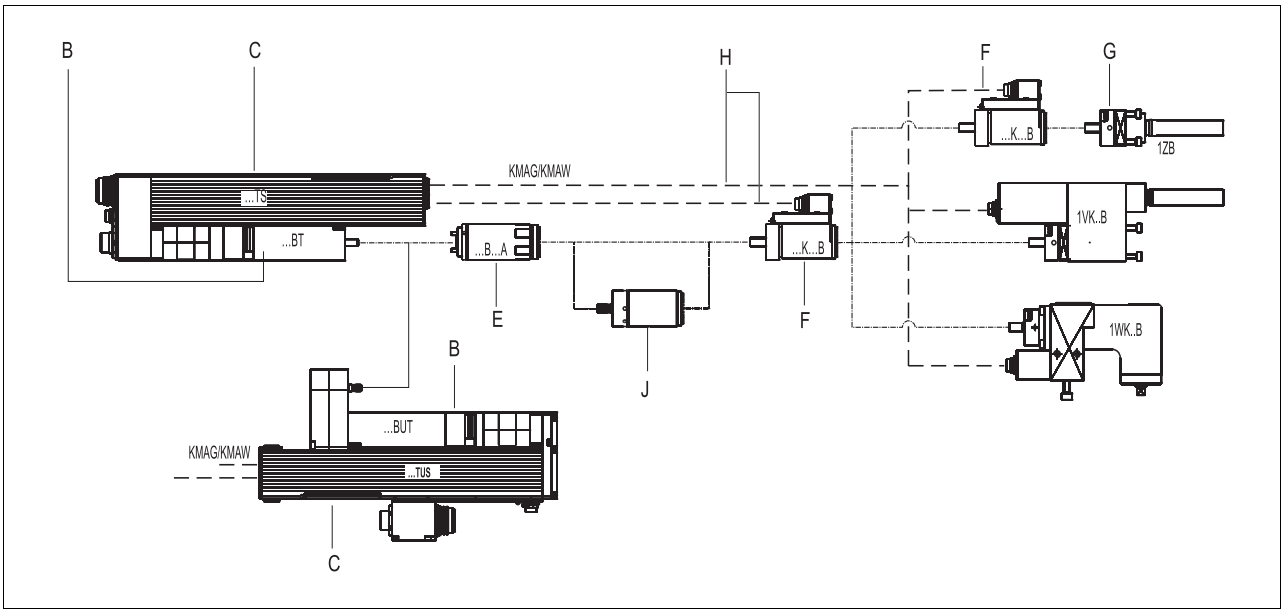
5.2.8 Size 4 – 2× transducer

Designation	Order No.	Torque Nm		Speed	Spring travel		min. axis distance	Length	Weight	Spring Chuck	
		max.	min.	rpm	mm		mm	mm	kg		+ flange
4BTS-4B500A-2/4K2B-4ZA	947590A9	500	100	254	50	3/4"	91	846	24	–	916643
4BTS-4B660A-2/4K3B-4ZA	947602A4	660	130	174		1"					916642
4BTS-4B360A-2/4K1B-4Z1250A	947618A6	1250	320	86		1"	121	899	32		S976956
4BTS-4B500A-2/4K2B-4Z1600A	947622A0	1600	400	68		1 1/2"					S308441
4BTS-4B500A-4K2B-4VK2B	947592A7	500	100	238		3/4"	76	812	25.5	912106	S308440
4BTS-4B660A-4K3B-4VK3B	947604A2	660	130	163		1"				912147	
4BTS-4B660A-4K3B-4VK4B	947608A8	750	160	135		1"					
4BTS-4B500A-4K2B-4WK2B	947594A5	500	100	245	25	3/4"	112	856	30.1	–	929077
4BTS-4B660A-4K3B-4WK3B	947606A0	660	130	167		1"					929089
4BUTS-4B500A-2/4K2B-4ZA	947596A3	500	100	254	50	3/4"	91	674	25.5	–	916643
4BUTS-4B660A-2/4K3B-4ZA	947610A4	660	130	174		1"					916642
4BUTS-4B360A-2/4K1B-4Z1250A	947620A2	1250	320	86		1"	121	726	34		S976956
4BUTS-4B500A-2/4K2B-4Z1600A	947624A8	1600	400	68		1 1/2"					S308441
4BUTS-4B500A-4K2B-4VK2B	947598A1	500	100	238		3/4"	76	639	27	912106	S308440
4BUTS-4B660A-4K3B-4VK3B	947612A2	660	130	163		1"				912147	
4BUTS-4B660A-4K3B-4VK4B	947616A8	750	160	135		1"			27.5		
4BUTS-4B500A-4K2B-4WK2B	947600A6	500	100	245	25	3/4"	112	684	31.6	–	929077
4BUTS-4B660A-4K3B-4WK3B	947614A0	660	130	167		1"			31.7		929089

Smallest scribed circle diameter in mm

Quantity	Attachment		
DGD-IS	Centric	Offset	Angle head
2	91	76	112
3	122	88	130
4	130	108	160
5	174	130	192
6	217	153	224
7	246	180	263

5.3 Component overview



5.3.1 Size 1 / 1× transducer

DGD-IS		B		C		E		F		G		H		J**
1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	2)
1BTS-1B012A-1K3B-1ZB	947541A8	1BT	935560	TS	961146	1B012A	927346	1K3B	934285	1ZB	927222	KMAW	961089-002	–
1BTS-1B035A-1K1B-1ZB	947553A4					1B035A	927344	1K1B	934283					
1BTS-1B060A-1K2B-1ZB	947565A0					1B060A	927345	1K2B	934284					
1BTS-1B012A-1VK3B	947543A6					1B012A	927346	–	–	1VK3B	935860	KMAG	961088-004	
1BTS-1B035A-1VK1B	947555A2					1B035A	927344			1VK1B	935862			
1BTS-1B060A-1VK2B	947567A8					1B060A	927345			1VK2B	935861			
1BTS-1B012A-1WK3B	947545A4					1B012A	927346			1WK3B	934366		961088-003	
1BTS-1B035A-1WK1B	947557A0					1B035A	927344			1WK1B	934364			
1BTS-1B060A-1WK2B	947569A6					1B060A	927345			1WK2B	934365			
1BUTS-1B012A-1K3B-1ZB	947547A2	1BUT	936321	TUS	961147	1B012A	927346	1K3B	934285	1ZB	927222	KMAW	961088-004	935796
1BUTS-1B035A-1K1B-1ZB	947559A8					1B035A	927344	1K1B	934283					
1BUTS-1B060A-1K2B-1ZB	947571A2					1B060A	927345	1K2B	934284					
1BUTS-1B012A-1VK3B	947549A0					1B012A	927346	–	–	1VK3B	935860	KMAG	961088-003	
1BUTS-1B035A-1VK1B	947561A4					1B035A	927344			1VK1B	935862			
1BUTS-1B060A-1VK2B	947573A0					1B060A	927345			1VK2B	935861			
1BUTS-1B012A-1WK3B	947551A6					1B012A	927346			1WK3B	934366			–
1BUTS-1B035A-1WK1B	947563A2					1B035A	927344			1WK1B	934364			
1BUTS-1B060A-1WK2B	947575A8					1B060A	927345			1WK2B	934365			

1) Code

2) Part no.

** assembled as spacer

5.3.2 Size 1 / 2× transducer

DGD-IS		B		C		E		F		G		H	
1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)
1BTS-1B012A-2/1K3B-1ZB	947542A7	1BT	935560	TS	961146	1B012A	927346	1K3B	934285 (2×)	1ZB	927222	KMAW	961089-002 (2×)
1BTS-1B035A-2/1K1B-1ZB	947554A3					1B035A	927344	1K1B	934283 (2×)				
1BTS-1B060A-2/1K2B-1ZB	947566A9					1B060A	927345	1K2B	934284 (2×)				
1BTS-1B012A-1K3B-1VK3B	947544A5					1B012A	927346	1K3B	934285	1VK3B	935860	KMAG KMAW	961088-004 961089-002
1BTS-1B035A-1K1B-1VK1B	947556A1					1B035A	927344	1K1B	934283	1VK1B	935862		
1BTS-1B060A-1K2B-1VK2B	947568A7					1B060A	927345	1K2B	934284	1VK2B	935861		
1BTS-1B012A-1K3B-1WK3B	947546A3					1B012A	927346	1K3B	934285	1WK3B	934366	KMAG KMAW	961088-003 961089-002
1BTS-1B035A-1K1B-1WK1B	947558A9					1B035A	927344	1K1B	934283	1WK1B	934364		
1BTS-1B060A-1K2B-1WK2B	947570A3					1B060A	927345	1K2B	934284	1WK2B	934365		
1BUTS-1B012A-2/1K3B-1ZB	947548A1	1BUT	936321	TUS	961147	1B012A	927346	1K3B	934285 (2×)	1ZB	927222	KMAW	961089-004 (2×)
1BUTS-1B035A-2/1K1B-1ZB	947560A5					1B035A	927344	1K1B	934283 (2×)				
1BUTS-1B060A-2/1K2B-1ZB	947572A1					1B060A	927345	1K2B	934284 (2×)				
1BUTS-1B012A-1K3B-1VK3B	947550A7					1B012A	927346	1K3B	934285	1VK3B	935860	KMAG KMAG	961088-003 961088-004
1BUTS-1B035A-1K1B-1VK1B	947562A3					1B035A	927344	1K1B	934283	1VK1B	935862		
1BUTS-1B060A-1K2B-1VK2B	947574A9					1B060A	927345	1K2B	934284	1VK2B	935861		
1BUTS-1B012A-1K3B-1WK3B	947552A5					1B012A	927346	1K3B	934285	1WK3B	934366	KMAG	961088-004 (2×)
1BUTS-1B035A-1K1B-1WK1B	947564A1					1B035A	927344	1K1B	934283	1WK1B	934364		
1BUTS-1B060A-1K2B-1WK2B	947576A7					1B060A	927345	1K2B	934284	1WK2B	934365		

1) Code

2) Part no.

* included in B

5.3.3 Size 2 / 1× transducer

DGD-IS		B		C		E		F		G		H	
1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)
2BTS-2B110A-2K1B-2ZB	947517A8	2BT	935561	TS	961146	2B110A	935548	2K1B	934293	2ZB	927227	KMAW	961089-002
2BTS-2B200A-2K3B-2ZB	947529A4					2B200A	935549	2K3B	934292				
2BTS-2B110A-2VK1B	947521A2					2B110A	935548	–	–	2VK1B	934334	KMAG	961088-004
2BTS-2B200A-2VK3B	947533A8					2B200A	935549			2VK3B	934333		
2BTS-2B110A-2WK1B	947525A8					2B110A	935548			2WK1B	934372	KMAG	961088-003
2BTS-2B200A-2WK3B	947537A4					2B200A	935549			2WK3B	934373		
2BUTS-2B110A-2K1B-2ZB	947519A6	2BUT	936322	TUS	961147	2B110A	935548	2K1B	934293	2ZB	927227	KMAG	961088-004
2BUTS-2B200A-2K3B-2ZB	947531A0					2B200A	935549	2K3B	934292				
2BUTS-2B110A-2VK1B	947523A0					2B110A	935548	–	–	2VK1B	934334	KMAG	961088-003
2BUTS-2B200A-2VK3B	947535A6					2B200A	935549			2VK3B	934333		
2BUTS-2B110A-2WK1B	947527A6					2B110A	935548			2WK1B	934372	KMAG	961088-004
2BUTS-2B200A-2WK3B	947539A2					2B200A	935549			2WK3B	934373		

1) Code

2) Part no.

5.3.4 Size 2 / 2× transducer

DGD-IS		B		C		E		F		G		H	
1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)
2BTS-2B110A-2/2K1B-2ZB	947518A7	2BT	935561	TS	961146	2B110A	935548	2K1B	934293 (2×)	2ZB	927227	KMAG KMAW	961088-003 961089-002
2BTS-2B200A-2/2K3B-2ZB	947530A1					2B200A	935549	2K3B	934292 (2×)				
2BTS-2B110A-2K1B-2VK1B	947522A1					2B110A	935548	2K1B	934293	2VK1B	934334	KMAG KMAW	961088-003 961089-002
2BTS-2B200A-2K3B-2VK3B	947534A7					2B200A	935549	2K3B	934292	2VK3B	934333		
2BTS-2B110A-2K1B-2WK1B	947526A7					2B110A	935548	2K1B	934293	2WK1B	934372		
2BTS-2B200A-2K3B-2WK3B	947538A3					2B200A	935549	2K3B	934292	2WK3B	934373		
2BUTS-2B110A-2/2K1B-2ZB	947520A3	2BUT	936322	TUS	961147	2B110A	935548	2K1B	934293 (2×)	2ZB	927227	KMAG KMAG	961088-004 961088-005
2BUTS-2B200A-2/2K3B-2ZB	947532A9					2B200A	935549	2K3B	934292 (2×)				
2BUTS-2B110A-2K1B-2VK1B	947524A9					2B110A	935548	2K1B	934293	2VK1B	934334	KMAG KMAG	961088-004 961088-005
2BUTS-2B200A-2K3B-2VK3B	947536A5					2B200A	935549	2K3B	934292	2VK3B	934333		
2BUTS-2B110A-2K1B-2WK1B	947528A5					2B110A	935548	2K1B	934293	2WK1B	934372		
2BUTS-2B200A-2K3B-2WK3B	947540A9					2B200A	935549	2K3B	934292	2WK3B	934373		

1) Code

2) Part no.

5.3.5 Size 3 / 1× transducer

DGD-IS		B		C		E		F		G		H	
1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)
3BTS-3B300A-3K2B-3ZB	947577A6	3/4BT	935562	TS	961146	3B300A	935590	3K2B	934302	3ZB	927233	KMAG	961088-002
3BTS-3B300A-3VK2B	947579A4							–	–	3VK2B	934342	KMAG	961088-004
3BTS-3B300A-3WK2B	947581A0									3WK2B	934382	KMAG	961088-003
3BUTS-3B300A-3K2B-3ZB	947583A8	3/4BUT	936323	TUS	961147			3K2B	934302	3ZB	927233	KMAG	961088-004
3BUTS-3B300A-3VK2B	947585A6							–	–	3VK2B	934342		
3BUTS-3B300A-3WK2B	947587A4									3WK2B	934382		

1) Code

2) Part no.

5.3.6 Size 3 / 2× transducer

DGD-IS		B		C		E		F		G		H	
1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)
3BTS-3B300A-2/3K2B-3ZB	947578A5	3/4BT	935562	TS	961146	3B300A	935590	3K2B	934302 (2×)	3ZB	927233	KMAG	961088-002 961088-003
3BTS-3B300A-3K2B-3VK2B	947580A1							3K2B	934302	3VK2B	934342		
3BTS-3B300A-3K2B-3WK2B	947582A9									3WK2B	934382		
3BUTS-3B300A-2/3K2B-3ZB	947584A7	3/4BUT	936323	TUS	961147			3K2B	934302 (2×)	3ZB	927233	KMAG	961088-005 961088-006
3BUTS-3B300A-3K2B-3VK2B	947586A5							3K2B	934302	3VK2B	934342	KMAG	961088-005 (2×)
3BUTS-3B300A-3K2B-3WK2B	947588A3									3WK2B	934382		

1) Code

2) Part no.

5.3.7 Size 4 / 1× transducer

DGD-IS		B		C		E		F		G		H	
1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)
4BTS-4B500A-4K2B-4ZA	947589A2	3/4BT	935562	TS	961146	4B500A	935780	4K2B	934315	4ZA	927236	KMAG	961088-002
4BTS-4B660A-4K3B-4ZA	947601A5					4B660A	935781	4K3B	934316				
4BTS-4B360A-4K1B-4Z1250A	947617A7					4B360A	929541	4K1B	934314	4Z1250A	S976950		
4BTS-4B500A-4K2B-4Z1600A	947621A1					4B500A	935780	4K2B1	934317	4Z1600A	S976951		
4BTS-4B500A-4VK2B	947591A8					4B500A	935780	–	–	4VK2B	934353	kMAG	961088-004
4BTS-4B660A-4VK3B	947603A3					4B660A	935781			4VK3B	934354		
4BTS-4B660A-4VK4B	947607A9					4B660A	935781			4VK4B	934355		
4BTS-4B500A-4WK2B	947593A6					4B500A	935780			4WK2B	934393	KMAG	961088-003
4BTS-4B660A-4WK3B	947605A1					4B660A	935781			4WK3B	934394		

DGD-IS		B		C		E		F		G		H	
1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)
4BUTS-4B500A-4K2B-4ZA	947595A4					4B500A	935780	4K2B	934315	4ZA	927236		
4BUTS-4B660A-4K3B-4ZA	947609A7					4B660A	935781	4K3B	934316				
4BUTS-4B360A-4K1B-4Z1250A	947619A5					4B360A	929541	4K1B	934314	4Z1250A	S976950		
4BUTS-4B500A-4K2B-4Z1600A	947623A9					4B500A	935780	4K2B1	934317	4Z1600A	S976951		
4BUTS-4B500A-4VK2B	947597A2	3/4BUT	936323	TUS	961147	4B500A	935780			4VK2B	934353	KMAG	961088-005
4BUTS-4B660A-4VK3B	947611A3					4B660A	935781			4VK3B	934354		
4BUTS-4B660A-4VK4B	947615A9					4B660A	935781	–	–	4VK4B	934355		
4BUTS-4B500A-4WK2B	947599A0					4B500A	935780			4WK2B	934393		
4BUTS-4B660A-4WK3B	947613A1					4B660A	935781			4WK3B	934394		

1) Code

2) Part no.

5.3.8 Size 4 / 2× transducer

DGD-IS		B		C		E		F		G		H	
1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)	1)	2)
4BTS-4B500A-2/4K2B-4ZA	947590A9					4B500A	935780	4K2B	934315 (2×)	4ZA	927236		
4BTS-4B660A-2/4K3B-4ZA	947602A4					4B660A	935781	4K3B	934316 (2×)				
4BTS-4B360A-2/4K1B-4Z1250A	947618A6					4B360A	929541	4K1B	934314 (2×)	4Z1250A	S976950		
4BTS-4B500A-2/4K2B-4Z1600A	947622A0	3/4BT	935562	TS	961146	4B500A	935780	4K2B1	934317 (2×)	4Z1600A	S976951	KMAG KMAG	961088-002 961088-003
4BTS-4B500A-4K2B-4VK2B	947592A7					4B500A	935780	4K2B	934315	4VK2B	934353		
4BTS-4B660A-4K3B-4VK3B	947604A2					4B660A	935781	4K3B	934316	4VK3B	934354		
4BTS-4B660A-4K3B-4VK4B	947608A8					4B660A	935781	4K3B	934316	4VK4B	934355		
4BTS-4B500A-4K2B-4WK2B	947594A5					4B500A	935780	4K2B	934315	4WK2B	934393		
4BTS-4B660A-4K3B-4WK3B	947606A0					4B660A	935781	4K3B	934316	4WK3B	934394		
4BUTS-4B500A-2/4K2B-4ZA	947596A3					4B500A	935780	4K2B	934315 (2×)	4ZA	927236	KMAG	961088-006 (2×)
4BUTS-4B660A-2/4K3B-4ZA	947610A4					4B660A	935781	4K3B	934316 (2×)				
4BUTS-4B360A-2/4K1B-4Z1250A	947620A2					4B360A	929541	4K1B	934314 (2×)	4Z1250A	S976950		
4BUTS-4B500A-2/4K2B-4Z1600A	947624A8	3/4BUT	936323	TUS	961147	4B500A	935780	4K2B1	934317 (2×)	4Z1600A	S976951	KMAG	961088-005
4BUTS-4B500A-4K2B-4VK2B	947598A1					4B500A	935780	4K2B	934315	4VK2B	934353	KMAG	961088-006
4BUTS-4B660A-4K3B-4VK3B	947612A2					4B660A	935781	4K3B	934316	4VK3B	934354		
4BUTS-4B660A-4K3B-4VK4B	947616A8					4B660A	935781	4K3B	934316	4VK4B	934355		
4BUTS-4B500A-4K2B-4WK2B	947600A6					4B500A	935780	4K2B	934315	4WK2B	934393		
4BUTS-4B660A-4K3B-4WK3B	947614A0					4B660A	935781	4K3B	934316	4WK3B	934394		

1) Code

2) Part no.

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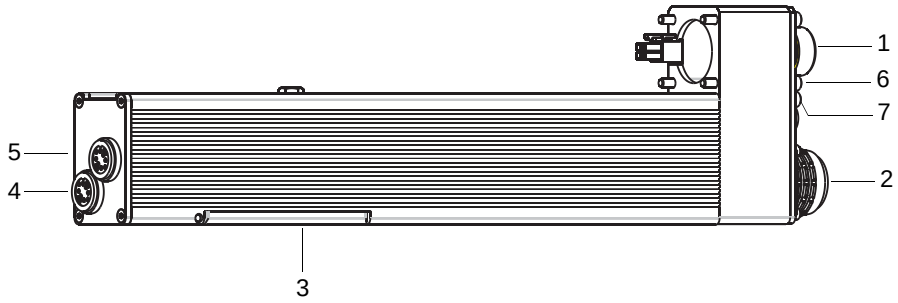
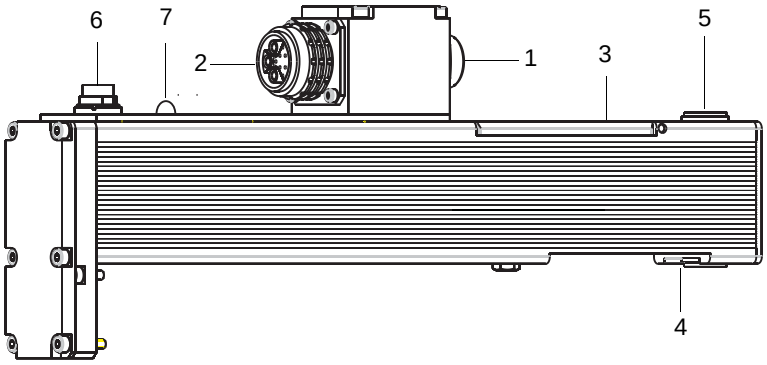
6 Tightening module TS/TUS



TS
Order No. 961146



TUS
Order No. 961147

Item	Designation
1	"XS1A" supply input
2	"XS1B" supply output
3	Service panel
4	"XS3" transducer plug connector
5	"XS4" plug connector for (second) redundant transducer
6	"XS2" plug connector, crosscheck with measuring case
7	"Ready" LED, *ready for operation* (green) or fault (red)

6.1 Description

The TS/TUS tightening module controls the DGD-IS.
The servo amplifier (output section) and the measuring section (measuring board) are integrated in the tightening module.
Both circuit boards are linked to the connections via cables and plug connectors.

6.2 General technical data

Features	Data
Weight: TS TUS	 52.2 oz (1480 g) 52.9 oz (1500 g)
Protection category – is attained when all connectors are plugged in and the service panel is closed.	IP54
Cooling type	Convection (self-cooling)
Servicelife, operating	40,000 h
Usability period if stored	100,000 h (approx. 11 years)
Acceleration of each axis	max. 100 m/s²

6.2.1 Power loss

Low-loss components generate minimal heat.
Extremely good heat dissipation. Overall housing serves as a cooling element.

Standby 9 A

Operation max. 40 W

WARNING!

High temperature –
the tightening module TS/TUS may heat up and cause burns during removal (max. temperature 70 °C). Wear gloves.

6.2.2 Power supply 380 VDC

Intermediate power circuit (380 VDC) and logic power (24 VDC) are supplied separately by the nutsetter control unit. The intermediate power circuit is switched off separately by the nutsetter control unit after an *emergency stop*. The logic section remains connected to the power.

Performance data – various DGD-IS

Features		Data			
		1B(U)TS…	2B(U)TS…	3B(U)TS…	4B(U)TS…
Supply voltage	VDC	380 ±10 %			
Rated supply current	A	0.5	1	2	2
Peak supply current	A	6	15	15	15

6.2.3 Logic power supply

The logic power supply in the tightening module generates all supply voltages (24 V from the nutsetter control unit).

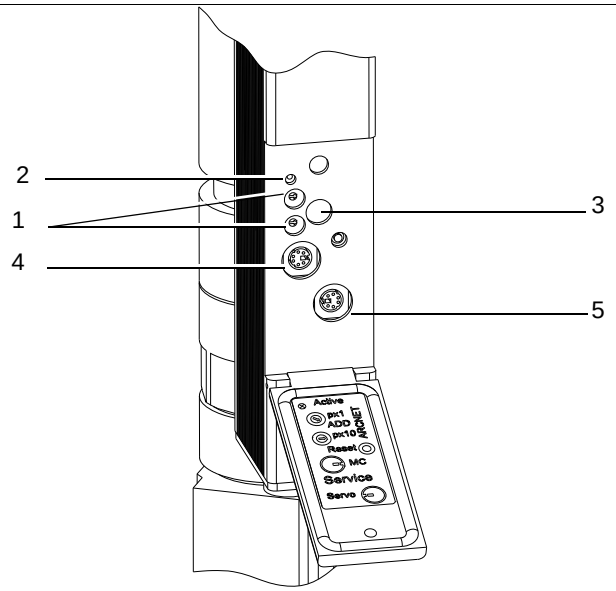
Features		Data
Supply voltage	V	24 +10 %
Rated supply current	A	approx. 0.35
Power loss (standby)	W	9

6.3 "Ready" LED

The "Ready" LED indicates that the system is *ready for operation*:

Signal	Tightening module
Green	Ready for operation
Red	Not ready for operation, an error is pending (see 15 Troubleshooting, Seite 69)

6.4 Service panel



Item	Designation
1	ARCNET address preset
2	"Active" LED
3	<Reset> button
4	DGD service interface (RS232) for measuring board
5	DGD service interface (RS232) for servo

a00601.wmf

6.4.1 ARCNET address preset

The ARCNET address is preset via the two 10-stage decode switch.
Permitted settings 01 to 32.

- Switch (x1) for units (00-09),
- Switch (x10) for tens (00-30).

NOTES

- Always switch off the nutsetter control unit before making adjustments.
- Each address can be used only once in the system. Otherwise an error is triggered on the m-Pro-400S-CPM….

6.4.2 "Active" LED

The "Active" LED indicates which activities the ARCNET is performing.

Signal	Activity
LED lights up	Data transfer to the ARCNET
LED flashes	ARCNET reconfiguration / transfer is disrupted
LED off	Internal fault / no power available

6.4.3 <Reset> button

Press the <Reset> button to acknowledge faults. You will require a pointed object such as a ball-point pen. Pressing this button resets the processor and reconfigures all functions.

6.4.4 DGD service interface (RS232) for measuring board

NOTE

Only for DGD Service

- Connection to PC via special cable
- Plug connector type: PS2

Pin	Signal	Description
1	RxD	±10 V
2	TxD	±10 V
3	VCC	3.3 V ±2% / 20 mA
4, 5, 6	-	-
Housing	GND	0 V

6.4.5 DGD service interface (RS232) for servo

NOTE

Only for DGD Service

- Connection to PC via special cable
- Plug connector type: PS2

Pin	Signal	Description
1	RxD	±10 V
2	TxD	±10 V
3	VCC	3.3 V ±2% / 20 mA
4	AMON	Analog monitor, 0 V – 3.3 V
5	AIN	Analog preset, 0 V – 3.3 V
6	START	Start signal to servo, 0 V (start) / 3.3 V
Housing	GND	0 V

6.5 Internal assemblies

6.5.1 Power adapters

The internal power adapters supply power to all electronic assemblies in the tightening module.

- All generated voltages are short-circuit proof.
- Galvanic isolation of ARCNET output stage from all other power supplies.
- Pulse frequency of the converter is 80 kHz.

Power supply	Generated voltage V	Maximum current A
Internal – servo section logic	3.3 (3.2 – 3.4)	0.5
Internal – servo section analog	5.0 (4.9 – 5.1)	0.5
Internal – servo section analog	15.0 (14.25 – 15.75)	0.12
Internal – measuring section logic	1.9 (1.78 – 2.02)	1
Internal – measuring section analog	2.5 (2.4 – 2.6)	1
Internal – measuring section analog	3.3 (3.2 – 3.4)	0.5
Internal – measuring section analog	12.0 (11.4 – 12.6)	0.5
Transducer	12.0 (11.8 – 12.2)	0.6
ARCNET output stage	5.0 (4.8 – 5.2)	0.2

6.5.2 Motor end stage

- Short-circuit proof: Phase – phase, phase – PE, phase – temperature monitor.
- Minimum losses due to IGBT end stage.

Features		Data
Intermediate circuit voltage U_Z	VDC	380 ±10 %
Excess voltage shut-off	VDC	> 480
Low voltage shut-off	VDC	< 160
Rated output at 50 °C	VA	1000
Peak power, momentary	VA	8000
Peak current, maximum	A	65
Current-controlled shut-off, short circuit	A	100
Efficiency	%	approx. 98
Pulse frequency of the PWM	KHz	10

6.5.3 Measuring board

NOTE

The measuring board is a component of the tightening module and should not be replaced separately.

- Separate processors for measuring and communication tasks.
- Two separate measuring channels for torque and angle tracking (2 tracks each).
- Measuring software in FLASH memory.
  The station controller m-Pro-400S updates the software via the ARCNET.
- Press the button under the service panel to reset, see 6.4.3 <Reset> button, Seite 30.
- Torque measuring accuracy 0.2 %.
- Resolution 12 bits at ±6.6 V, therefore approx. 6.5 mV.
- Measurement sampling rate, 3300 measurements per second.
- Analog filter for torque signals 1 KHz.
- Maximum angle frequency 12 KHz, corresponds to 2000 revolutions per minute of the DGD-IS attachment with a resolution of 1 pulse per degree.
- Angle redundancy only available for one transducer.
- Current redundancy possible by measuring the motor current transferred by the servo amplifier.
- Measuring the motor angle signals transferred by the servo amplifier via the synchronous serial interface (SSIO). These are generated from the resolver signals.

Communication between measuring board and servo amplifier

- A synchronous serial interface (SSIO) provides a means of communication between the servo amplifier and the measuring board.
- For safety reasons, the start signal is transferred from the measuring board to the servo amplifier both via a separate input/output and via the SSIO.

Communication between tightening module and station controller

- The two units communicate via the ARCNET high-performance field bus.
- The transfer rate is 2.5 MBd.

7 Attachment

7.1 Centric attachment

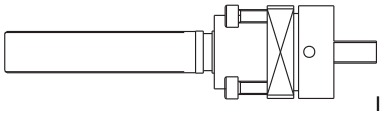
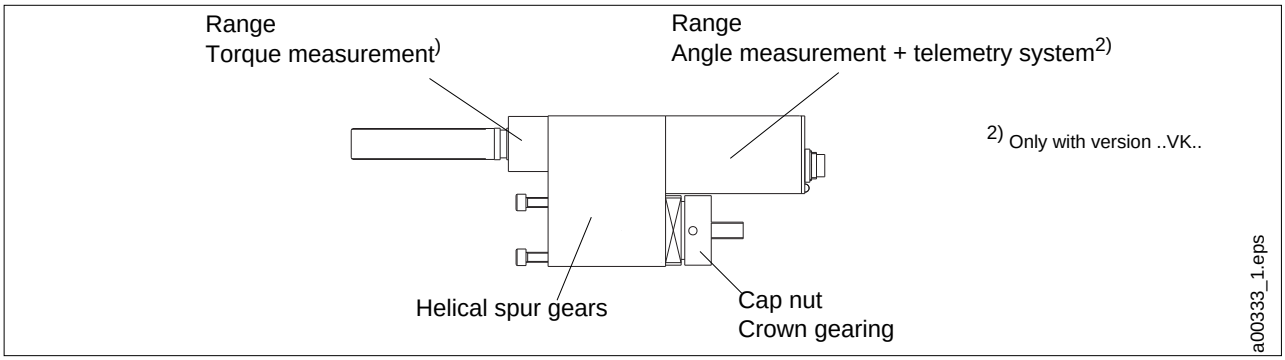


Illustration of 1ZB

Code	Order no.	Ratio i	Permissible load on output shaft			Lateral force at wrench head[1]		
			TQ Nm	Pressure [1] N	Tension [1] N	Extended N	25 mm Retracted N	50 mm Retracted N
1ZB	927222	1:1	53	1900	1500	1150	1350	1600
2ZB	927227		200	4500	3200	2450	2700	3250
3ZB	927233		300	6500	5000	3000	3500	4100
4ZA	927236		660	9000	8800	4300	4800	5400
4Z1250A	S976950	3.7368	1250	9000	8800	4300	4800	5400
4Z1600A	S976951	3.7368	1600					

1) During continuous operation for long periods, multiply the specified values by 0.3

7.2 Offset attachment



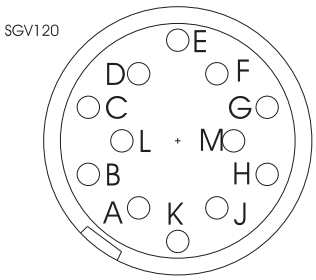
Code	Order no.	Torque Calibration	Ratio i	Permissible load on output shaft			Lateral force at wrench head[1]		
				TQ Nm	Pressure [1] N	Tension [1] N	Extended N	25 mm Retracted N	50 mm Retracted N
1VK1B	935862	35	1.0526	53	2300	2300	1510	1720	2000
1VK2B	935861	60							
1VK3B	935860	12							
2VK1B	934334	170	1.0714	160	2500	2500	2300	2600	3100
2VK3B	934333	200							
3VK2B	934342	300	1.0769	260	3600	3600	2850	3250	3750
4VK2B	934353	500	1.0667	660	6300	2100	4300	4800	5400
4VK3B	934354	660							
4VK4B	934355	900	1.2857	750					

1) Under continuous operation for long periods, multiply the specified values by 0.3

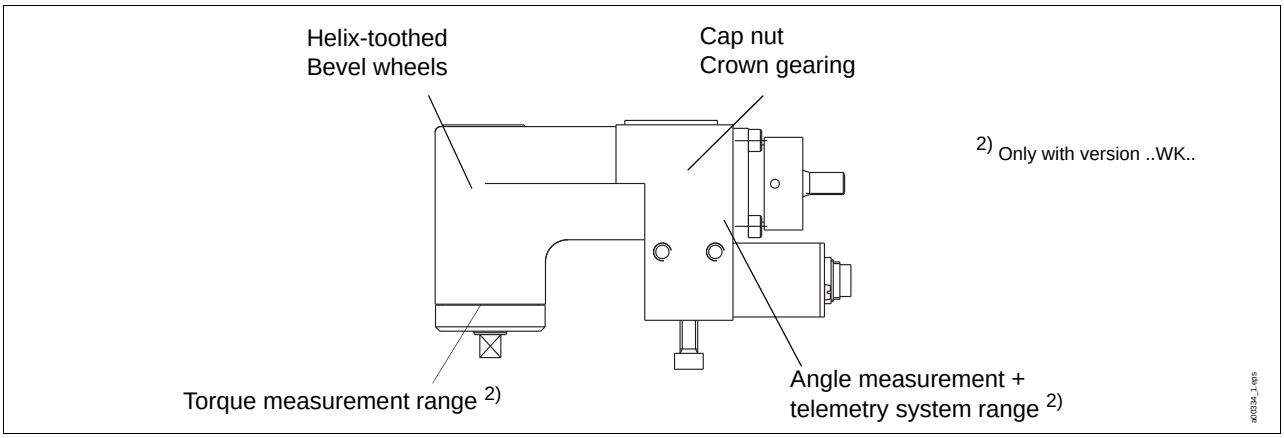
7.2.1 Pin configuration of offset attachment

Type: 12-pin circular connector Lumberg SGR 120, Binder series 680 no. 09-0331-90-12
with locking connector in accordance with DIN 45 321

Pin	Color	Signal	Description
A	-	-	nc
B	Brown	ANGA	Angle output A
C	Green	TQ	Torque output
D	Yellow	0 VA	0 V torque reference connection
E	gray	0 V	0 V supply
F	Pink	+12 V	Supply
G	Blue	ANGB	Angle output B
H	Red	RxD+	Interface
J	Black	RxD-	Interface
K	Violet	CAL	Input calibration voltage
L	Gray / pink	TxD-	Interface
M	Red / blue	TxD+	Interface
Housing		PE	Shield connection



7.3 Angle head attachment

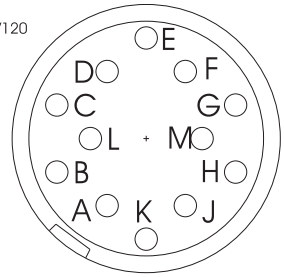


Code	Order no.	Torque Calibration	Ratio i	Permissible load on output shaft			Lateral force on square[1)]
				TQ Nm	Pressure [1)] N	Tension [1)] N	N
1WK1B	934364	35	1.0667	53	1700	3400	3100
1WK2B	934365	60					
1WK3B	934366	12					
2WK1B	934372	110	1.0625	200	1850	3900	4200
2WK3B	934373	200					
3WK2B	934382	300	1.0385	300	3800	4800	5100
4WK2B	934393	500	1.0370	660	1200	6500	5900
4WK3B	934394	660					

1) Under continuous operation for long periods, multiply the specified values by 0.3

7.3.1 Pin configuration angle head attachment

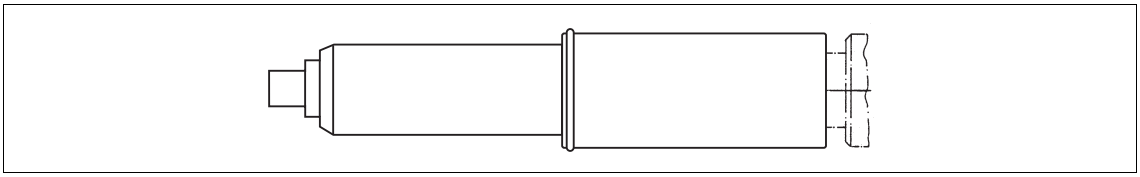
Type: 12-pin circular connector Lumberg SGR 120, Binder series 680 no. 09-0331-90-12
with locking connector in accordance with DIN 45 321

Pin	Color	Signal	Description	
A	-	-	nc	SGV120 
B	Brown	ANGA	Angle output A	
C	Green	TQ	Torque output	
D	Yellow	0 VA	0 V torque reference connection	
E	gray	0 V	0 V supply	
F	Pink	+12 V	Supply	
G	Blue	ANGB	Angle output B	
H	Red	RxD+	Interface	
J	Black	RxD-	Interface	
K	Violet	CAL	Input calibration voltage	
L	Gray / pink	TxD-	Interface	
M	Red / blue	TxD+	Interface	
Housing		PE	Shield connection	

7.4 Spring collet – Optional

7.4.1 For centric / offset attachment

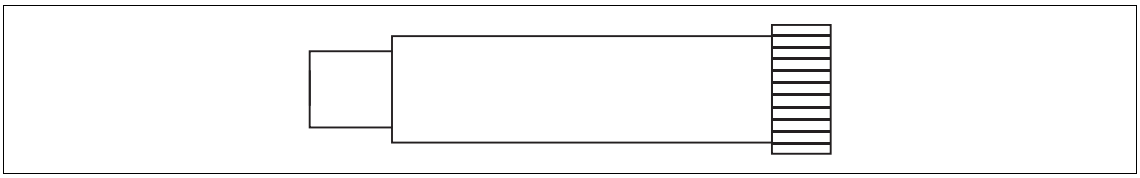
Size 1 – 4

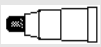


For	Order no.		Permissible load on output shaft			Lateral force at wrench head[1]			Weight
			TQ Nm	Pressure [1] N	Tension [1] N	Extended N	25 mm Retracted N	50 mm Retracted N	kg
1Z… / 1V…	922325	3/8"	53	2300	1500	1510	1720	2000	0.33
2Z… / 2V…	910609	1/2"	110	4500	3200	2300	2600	3100	0.45
	935553	3/4"	200						0,48
3Z… / 3V…	910613	3/4"	300	6500	5000	2850	3250	3750	0.67
4V…	912106	3/4"	500	9000	8800	4300	4800	5400	0.87
	912147	1"	750	9000	8800	4300	4800	5400	0.90
including flange housing									
1Z…	S308434	3/8"	53	2300	1500	1510	1720	2000	0.65
2Z…	S308435	1/2"	110	4500	3200	2300	2600	3100	1.05
3Z…	S308436	3/4"	300	6500	5000	2850	3250	3750	1.80

1) Under continuous operation for long periods, multiply the specified values by 0.3

Size 4Z..

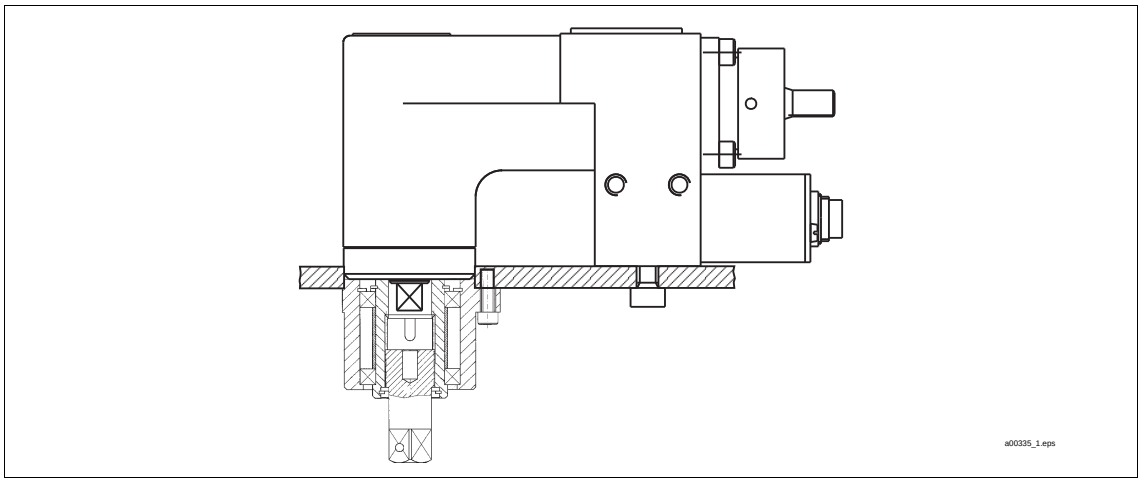


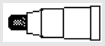
For	Order no.		Permissible load on output shaft			Lateral force at wrench head[1]			Weight
			TQ Nm	Pressure [1] N	Tension [1] N	Extended N	25 mm Retracted N	50 mm Retracted N	kg
4Z..	916643	3/4"	460	9000	8800	4300	4800	5400	1.21
	916642	1"	630						1.24

1) Under continuous operation for long periods, multiply the specified values by 0.3

7.4.2 For angle head including flange housing

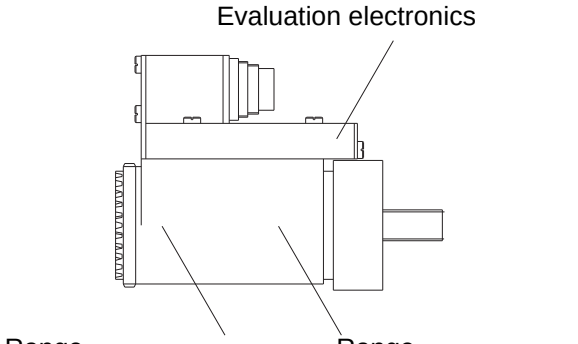
Stroke of spring: 25 mm



For	Order no.		Permissible load on output shaft			Lateral force at wrench head[1]	
			TQ Nm	Pressure [1] N	Tension [1] N	Extended N	25 mm Retracted N
1W..	929041	3/8"	53	1700	6800	1800	2100
2W..	929053	1/2"	110	1850	6800	2500	3000
	929061	3/4"	200	3800	7800	3000	3450
3W..	929065	3/4"	300	3800	7800	3000	3450
4W..	929077	3/4"	500	12000	13000	4300	5050
	929089	1"	660				

1) Under continuous operation for long periods, multiply the specified values by 0.3

8 Transducer



Size	Transducer …K…		
	Code	Order no.	Capacity / calibration value Nm
1	1K1KB	934283	35
	1K2KB	934284	60
	1K3KB	934285	12
2	2K1KB	934293	110
	2K3KB	934292	200
3	3K2KB	934302	300
4	4K1KB	934314	400
	4K2KB	934315	500
	4K2KB1	934317	500 (for 1600 Nm)
	4K3KB	934316	660

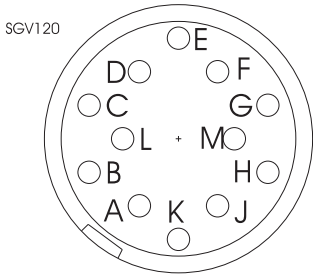
8.1 Electrical Data

Torque measurement features		Data
Nominal supply voltage	V	+12
Supply voltage limits	V	+10.75...+12.5
Supply current	mA	80
Measured output voltage – nominal voltage	V	-5…+5
Measured output voltage limits U_N	V	±5.000 ±0.5 % + U_0
Permitted measuring range of rated torque	%	±10...±125
Zero voltage limit value U_0	mV	±100
Nonlinearity / Torque measurement	% of U_N	±0.25
Measuring accuracy	% of U_N	±0.5
Output current, maximum	mA	5
Internal resistance Ri, torque output	Ω	<10
Limit frequency of the torque measurement (-3dB)	KHz	2
Measured output voltage calibration ON U_K	V	U_N ±0.25%
Calibration voltage, input ON	V	> 3.5
Calibration voltage, input OFF	V	< 2.0
Calibration voltage, maximum	V	35
Calibration input impedance	KΩ	5

Angle measurement features		Data
Angle resolution	Pulse/Degree Pulses/Rotation	1 360
Angle signals		2
Direction-dependent phase shifting, angle signals	Degrees	90 ±30
Output shut-off, angle outputs		Open collector with 10 kΩ to +12 V supply
Output current, maximum, angle outputs	mA	50
Electric strength, angle outputs	V	+20

8.2 Pin configuration of transducer

Type: 12-pin circular connector Lumberg SGR 120, Binder series 680 no. 09-0331-90-12
with locking connector in accordance with DIN 45 321

Pin	Color	Signal	Description	
A	-	-	nc	
B	Brown	ANGA	Angle output A	
C	Green	TQ	Torque output	
D	Yellow	0 VA	0 V torque reference connection	
E	gray	0 V	0 V supply	
F	Pink	+12 V	Supply	
G	Blue	ANGB	Angle output B	
H	Red	RxD+	Interface	
J	Black	RxD-	Interface	
K	Violet	CAL	Input calibration voltage	
L	Gray / pink	TxD-	Interface	
M	Red / blue	TxD+	Interface	
Housing		PE	Shield connection	

9 Gearing

Size	Gearing …B…		
	Code	Order no.	Ratio
1	1B012A	927346	5.7273
	1B035A	927344	15.1364
	1B060A	927345	25.7727
2	2B110A	935548	12.3595
	2B200A	935549	21.9231
3	3B300A	935590	18.7500
4	4B360A	929541	26.3118
	4B500A	935780	33.4219
	4B660A	935781	48.9345

10 Motor

10.1 Technical data

Features		Data					
Code		**1BT**	**1BUT**	**2BT**	**2BUT**	**3/4BT**	**3/4BUT**
Order no.		**935560**	**935563**	**935561**	**935564**	**935562**	**935565**
Speed, maximum	RPM	11000		11000		8500	
Operating mode according to VDE 0530		S 1		S 1		S 1	
Enclosure type according to DIN 40050		IP54		IP54		IP54	
Sense of rotation		Reversible		Reversible		Reversible	
Design		B 14		B 14		B 14	
Connection type		Plug connector		Plug connector		Plug connector	
Mass moment of inertia	$kgm^2 \times 10^{-3}$	0.017		0.06		0.25	
Rated torque	Nm	0.55		1.60		3	
Permanent torque, maximum at a stop	Nm	0.61		1.8		4	
Peak torque	Nm	2.8		10.5		18.3	
Speed change per torque	RPM / Ncm[1)]	12.2		1.9		0.34	
Mechanical time constants	ms	2.1		1.3		1.1	
Friction torque	Nm	0.03		0.07		0.15	
Rotor weight	kg	0.36		0.79		1.54	
Motor weight	kg	1.6		3.1		6.5	
Ball bearing	A/B side	6000/608		6200/6200		6202/6201	

10.2 Electrical Data

Features		Data		
		1BT/ 1BUT	2BT/ 2BUT	3/4BT/ 3/4BUT
Intermediate circuit voltage	V	380	380	380
Rated current [1]	A	2.1	6	8.7
Rated output	W	260	500	940
Number of phases		3	3	3
Terminating resistance [2]	Ohms	11	1.8	0.6
Inductance [2]	mH	6.5	3.1	2.4
Voltage constants[3]	mV/RPM	34	34	44
Torque constant [3]	Nm/A	0.28	0.28	0.36
Current at peak torque [1]	A	11	44	59
Max. peak current [1] [4]	A	20	54	73
Electrical time constants	ms	0.59	1.7	4

1) Sine peak value

2) Measured between two phases

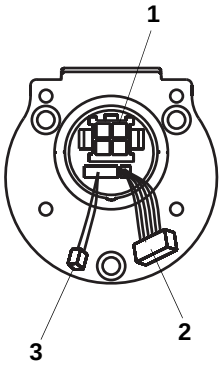
3) -10 %

4) The values specified apply to operation within the temperature range of 0 - 40° C. They may not be exceeded, even for a short period of time, since this would lead to the risk of a magnetic weakening.

10.3 Thermal data

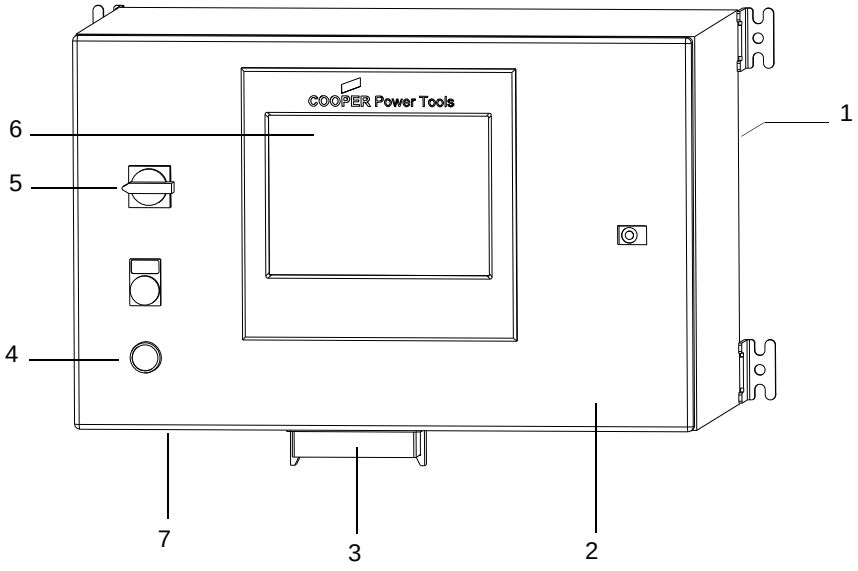
Features		Data		
		1BT/ 1BUT	2BT/ 2BUT	3/4BT/ 3/4BUT
Insulation class according to VDE 0530		F	F	F
Thermal time constants	min	17.5	25	35
Temperature rise without cooling	K/W	1.30	1.05	0.75

10.4 Pin configuration motor connector



Pin	Signal designation	Wire colors (in motor)	
		Motor type BT	Motor type BUT
Motor (1)			
4	PE	Green/yellow	
1	Phase S	Green	Green
2	Phase R	Black	Red
3	Phase T	Red	
Resolver (2)			
1	Resolver R1	Red/white	
2	Resolver R2	Yellow/white	
3	Resolver S1	Red	
4	Resolver S3	Black	
5	Resolver S2	Yellow	Blue
6	Resolver S4	Blue	Yellow
Temperature sensor (3)			
1	0 V	Black	
2	Signal	Red	

11 Nutsetter control unit m-Pro-400S-CPM…



Item	Designation
1	Cooling element, aluminum
2	Front door, lockable
3	Cable outlet
4	"Ready" indicator
5	Main switch
6	Station controller m-Pro-400S, touch screen
7	Supply module CPS3 (integrated)

11.1 Brief function description

The nutsetter control unit m-Pro-400S-CPM…

- controls the fastening sequence (m-Pro-400S).
- supplies the tightening module TS/TUS with 380 VDC (CPS3) and 24 VDC.

The machine control and the station controller m-Pro-400S transmit the signals "Control on" and "Emergency stop", which activate and deactivate the intermediate circuit voltage to the DGD-IS.

The integrated emergency stop safety relay PNOZ X3P activates and monitors two relays. The relays activate the supply voltage.

11.2 General technical data

Features		Data		
		…CPM3	…CPM6	…CPM9
Weight	kg	75	130	180
Protection category		IP54		
Cooling type		Convection (self-cooling)		
Servicelife, operating	h	40.000		
Usability period if stored	h	100,000 (approx. 11 years)		
On/Off switching cycles		5.000.000		
Safety requirements in accordance with EN 964-1		Category 4		

11.3 Electrical Data

Features		Datam-Pro-400S-CPM…		
		CPM3	CPM6	CPM9
Supply voltage	VAC	3 × 400 ±10%		
Frequency	Hz	50-60		
Rated current	A	3 x 5	3 x 10	3 x 15
Peak current, momentary	A	3 x 25	3 x 50	3 x 75
Rated output	VA	3000	6000	9000
Peak power, momentary	VA	30.000	60.000	90.000
Output voltage of intermediate power circuit	VDC	380 ±10%		
Nominal output current (380 VDC)	A	8	16	24
Output current, maximum (5 s)	A	80	160	240
Circuit breaker, 3-pin	A	32	32	50
Tripping characteristic		C	D	D
Control voltage / Output voltage	VDC	24 ±10%		
Output current, maximum (24 VDC)	A	5	10	20

11.3.1 Intermediate power circuit 380 VDC

The intermediate power circuit supplies the DGD-IS with 380 VDC.

- A safety isolating transformer converts the supply voltage to 3× 270 VAC, which is then supplied to the CPS3.
- The processor controls two integrated relays that limit the switch-on current. The main relay switches on after the system initializes. The intermediate circuit capacitors are charged via a resistor until the intermediate circuit voltage reaches approx. 380 VDC. The resistor is then bridged via a start-up relay.
- Energy is generated when the motor brakes, which causes the voltage to increase. The braking chopper with braking resistor integrated in the CPS3converts the excess energy into heat.
- When the circuit is switched off, the intermediate circuit capacitors is discharged via the braking resistor.

WARNING!

- Unplugging the system cable while still live may generate an electric arc and cause serious burns.
- The contacts may become damaged.

➔ Switch off the power supply to the m-Pro-400S-CPM… before unplugging or inserting the system cable!

11.4 Supply module CPS3

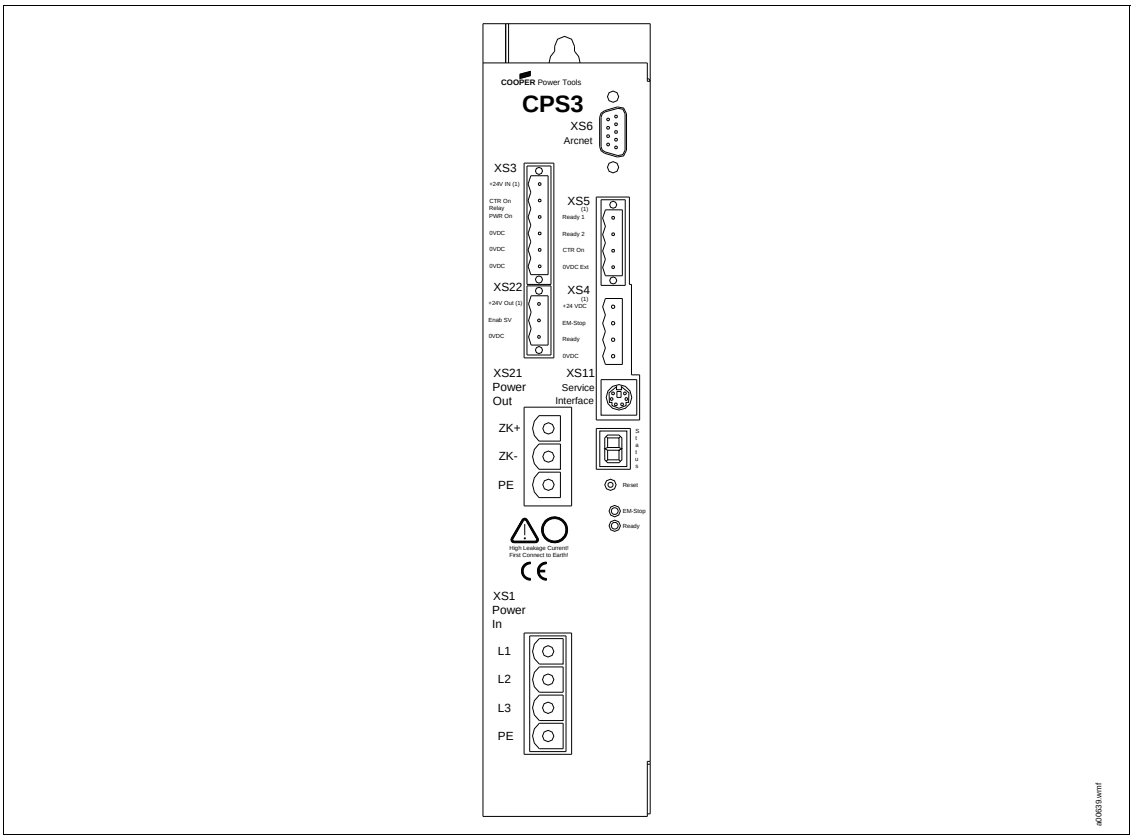
11.4.1 Description

The supply module CPS3 (Central Power Supply 3 KVA) is integrated in the nutsetter control unit:

- 1× in m-Pro-400S-CPM3
- 2× in m-Pro-400S-CPM6
- 3× in m-Pro-400S-CPM9

The CPS3 has the following functions:

- Rectification and smoothing of the intermediate circuit voltage to 380 VDC for the tightening module TS/TUS
- Switch-on current limiting
- Braking chopper
- Excess and low-voltage monitoring with intermediate circuit shut-off
- Short circuit and overcurrent monitoring
- Generation of *Ready* signal on the m-Pro-400S and machine control
- Evaluation of Emergency stop signal



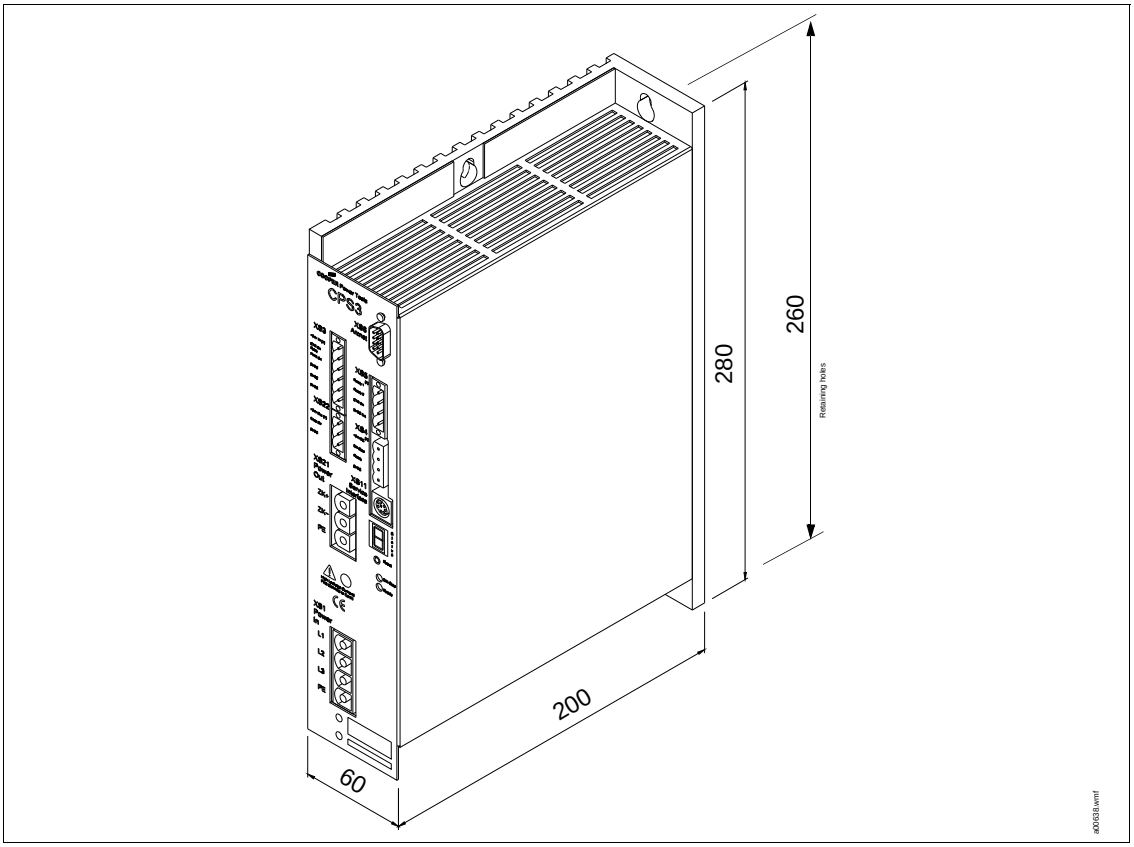
11.4.2 General technical data CPS3

Features		Data
Order No.		961112
Weight	G	3650
Protection category		IP20
Cooling type		Convection (self-cooling)
Servicelife, operating	h	40.000
On/Off switching cycles		5.000.000
Usability period if stored	h	100,000 (approx. 11 years)

11.4.3 Electrical DataCPS3

Features		Data
Supply voltage power	VAC	3 × 270 ±10%
Frequency	Hz	50 – 60
Rated current	A	3 × 7
Peak current, momentary in RMS mode	A	3 × 25
Rated output	VA	3000
Peak power, momentary in RMS mode	VA	30.000
Output voltage of intermediate power circuit	VDC	380 ±10 %
Nominal output current (380 VDC)	A	8
Output current, maximum (5 s)	A	80
Control supply voltage	VDC	24 ±10 %
Input current (without external load)	A	0.5
Control voltage / Output voltage	VDC	24 ±10 %
Output current, maximum (24 VDC)	A	8

11.4.4 Size



11.4.5 Indicators

LED

Signal	LED	CPS3
Green	"Ready"	Ready for operation
Red	"EM stop"	*Emergency stop* or *Control on* signal unavailable. The intermediate power circuit (380 VDC) is deactivated.

7-segment "Status" display

Error indicators, see 15.3.3 7-segment "Status" display, Seite 72.

11.4.6 <Reset> button

Press the <Reset> button to acknowledge faults. You will require a pointed object such as a ball-point pen. Pressing this button resets the processor and reconfigures all functions.

11.4.7 Plug connectors and configuration

WARNING!

- Unplugging the system cable while still live may generate an electric arc and cause serious burns.
- The contacts may become damaged.

Switch off the power supply to the m-Pro-400S-CPM… before unplugging or inserting the system cable!

"XS1 Power In"

Required connector type:
Phoenix Power Combicon PC6/4-ST-10,16
Order No. 961175

Contact	Signal	Description
L1	L1	Supply voltage 3 × 270 VAC
L2	L2	
L3	L3	
PE	PE	Earth conductor, connection to housing

"XS21 Power Out"

Power supply DGD-IS 380 VDC
Required connector type:
Phoenix Power Combicon IPC6/3-ST-10,16
Order No. 961188

Contact	Signal	Description
ZK+	+380 VDC	Intermediate circuit voltage +380 VDC ±10%
IC-	0 VDC	Intermediate circuit voltage 0 V
PE	PE	Earth conductor, connection to housing

"XS22" TS/TUS

24 V supply and *Enable servo* signal (end stage release signal) to DGD-IS
Required connector type:
Phoenix Combicon MSTB2.5/3-STF-5.08
Order No. S959935

Contact	Signal	Description
24 V	+24 V Out	Supply TS/TUS, 24 V +10%, max. 4 A (8 DGD-IS)
Enab SV	Enable servo	Enable servo output; End stage release; Active when no errors or *Emergency stop* pending 24 VDC, max. 0.3 A
0VDC	0V	Supply TS/TUS, 0 V

"XS3" logic supply and control on relay output

24 V supply for the CPS3 and control on relay connection for the power supply
Required connector type:

Phoenix Combicon MSTB2.5/6-STF-5.08
Order No. 961177

Contact	Signal	Description
+24 V IN (1)	+24 V IN	Supply of the logic in the CPS3, 24 V +10%
CTR on relay	CTR on relay	Control on output for external relay 24 VDC, max. 0.3 A
PWR on	PWR on	Power on output, 24 VDC, max. 0.3 A
0 VDC	0 VDC	0 V of 24 V
0 VDC	0 VDC	
0 VDC	0 VDC	

"XS4" m-Pro-400S

24 VDC supply for m-Pro-400S,
Emergency stop signal from the m-Pro-400S and *Ready* signal to the m-Pro-400S
Required connector type:
Phoenix Combicon IC2.5/4-STF-5.08,
Order No. 961178

Contact	Signal	Description
+24 VDC	+24 VDC	Supply output, 24 V, max. 2 A
EM stop	*Emergency stop*	*Emergency stop* input from m-Pro-400S
Ready	*Ready for operation*	*Ready* output to the m-Pro-400S, 24 VDC, max. 0.3 A
0 VDC	0 VDC	0 V

"**XS5" machine control**

Emergency stop signal from the machine control and *Ready* signal to the machine control
Required connector type:
Phoenix Combicon MSTB2.5/4-STF-5.08,
Order No. 961179

Contact	Signal	Description
Ready 1	*Ready for operation* Relay contact 1	*Ready* output, relay contact 1, max. 26 V, max. 100 mA
Ready 2	*Ready for operation* Relay contact 2	*Ready* output, relay contact 2, max. 26 V, max. 100 mA
CTR on	*Control on*	*Control on* or *Emergency stop* input, 24 V, 10 mA
0 VDC Ext	0 VDC Ext	0 V from input

"XS6" ARCNET

The CPS3 is not equipped with ARCNET.

11.5 Installation

Secure the m-Pro-400S-CPM… to the machine using 4 x M8 8.8 screws (Tq = 25 Nm).

11.5.1 Guidelines

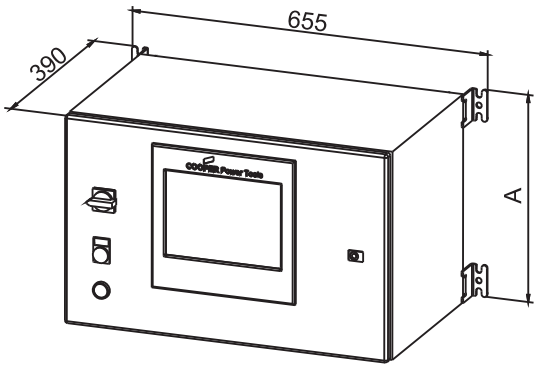
The m-Pro-400S-CPM… is ventilated by a natural convection system, an active fan is not required

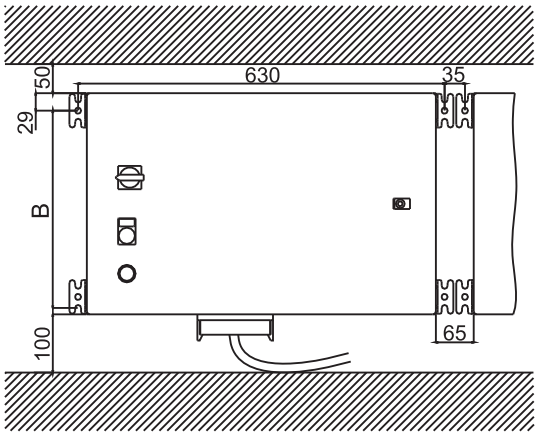
NOTE

- Warm air must not enter below the cooling element.
- No objects are allowed to obstruct the air flow below and above the cooling element (see hatching in the graphic 11.5.2 Dimensions, Seite 52).
- The m-Pro-400S-CPM… should not be exposed to direct sunlight.

11.5.2 Dimensions

	A mm	B mm
CPM3	380	340
CPM6	600	560
CPM9	760	720





12 Instructions on laying cables

12.1 General

- ➔ Don't bend cables while unrolling them. Don't create any loops or twists.
- ➔ Remember that a strain relief clamp and compression set must be incorporated within the bending radius.
- ➔ Don't use extra-long cables and wires (reserve). Avoid mutual interference.
- ➔ Lay so-called "hot" and "cold" signal lines separately.
  For this, use cable ducts in the control cabinet that are physically separated from each other.

Hot signal lines	System cable, mains, nutrunner control power supply, cooling unit
Cold signal lines	24 VDC, PE, ARCNet cable, bus cable, separate cables from transducers

CAUTION!

There is a risk of tripping or falling over loose cables on the ground.

- ➔ Lay all connected cables safely.

NOTE!

- ➔ Only cable types approved by DGD may be used.
- ➔ Remember that the maximum total cable length is **50 m**.
- ➔ Take appropriate measures to limit cable bending radii and torsion. Obverse the respective allowed bending radii and torsional lengths.
- ➔ All plug connections must be closed. The locks must be tightened. The red ring around the outer diameter of plug connectors with a slide lock should not be visible.

12.2 Strain relief clamp

NOTE!

➔ Generally all cable and hose components must be provided with traction reliefs at the beginning and end of the sections so that no tensile stresses can occur at connectors, plugs and rundowns.

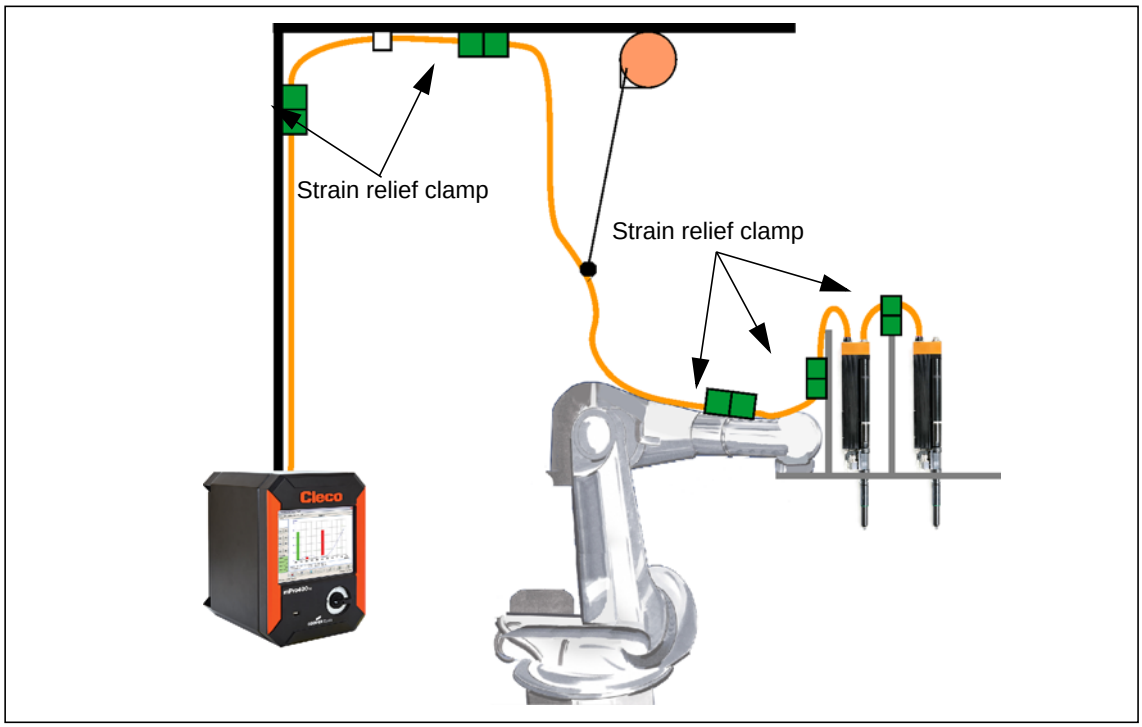


Fig. 12-1: Use with robot (example, other installations possible)

➔ Position the strain relief clamps so that the cables have maximum freedom of movement. Lay cables in slight loops such that the cables never become strained when the cable drag chain is pulled out. Cable pulls between the carriages or end stops on the rail can be of assistance.

We recommend: Run a few motion cycles after the initial installation of cables. Afterwards, check the cable installation once more and optimize it if possible.

➔ Only secure cables with strain relief clamps designed for the corresponding cable diameter. Use screw-on cable clips if possible. The clamping surface should be adjusted to the occurring tensile load. Too narrow of a clamping surface may cause the cable to fail prematurely.

➔ Avoid crushing individual wires or subcomponents.
We recommend applying a clamping force around the entire circumference of the cable.

➔ Only secure the cables at the strain relief clamp.

➔ A secure strain relief clamp prevents the cable from shifting inside the flexible cable duct.

12.3 Shielding

The shielding in the lines limits the expansion of perturbation energy into the surroundings and shields the system against disturbances.

The cables between tightening module and Built-in nutrunner or hand tool are shielded against exterior disturbances. However, this measure also counteracts interference emissions.

➔ Generally connect it to both ends.

➔ Extensively connect the shielding of the nutrunner cables (skin effect) to the lower edge of the tightening module housing with the aid of shield connecting elements.

For this, use the following shield clamps:

Cables	Shield clamp		
	DGD Order No.	Phoenix Name	Phoenix Item number
DGD-IS cable, BTS series	S961062	SK14	30 25 17 6
Hand tool cable	S961062	SK14	30 25 17 6

The shielding in the transducer line is connected to the connector housing. The front panel of the measuring board is grounded via the STM housing and ensures good shielding connection.

➔ Maximum unshielded area of the motor line, between shield end and plug connection on tightening module = 50 mm.

➔ On the Built-in nutrunner or hand tool, extensively connect the shield to the metal housing of the plug connection.

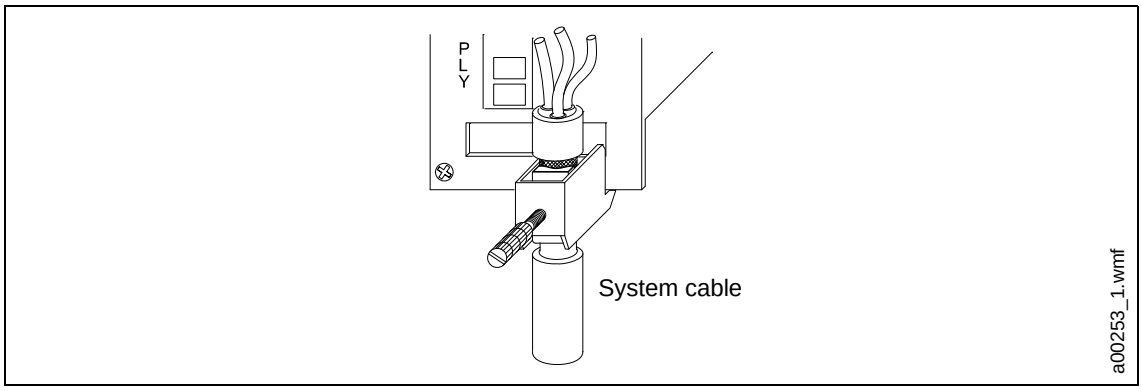
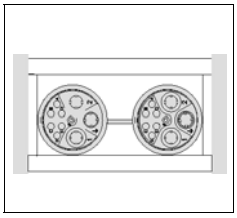


Fig. 12-2

12.4 Laying "High-Flex Quality" cables in cable ducts

The laying of lines and protection hoses in cable ducts must be carried out with the greatest possible care. Generally, the following points must be observed:



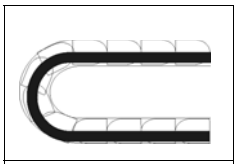
➔ The cables should lie free of twists in the cable duct.Prior to assembly, lay the cables on an even surface so that they can be inserted while stretched out.

➔ Lay the cables in the cable duct individually, lying loosely adjacent to each other whenever possible. Lay a maximum of 2 cables per partition.

➔ Separate cables lying adjacent to each other using cut-off bridges whenever possible.

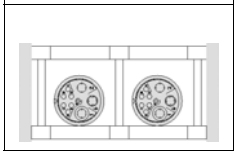
➔ Don't bundle cables or fasten them with cable ties.

➔ Never lay cables with different diameters (> 3 mm) together in the same partition.



➔ Cables must be able to follow the radius of curvature without being forced around it.

Vertical installation:



➔ Leave about 20% clearance within the partition height. The lines hang out downward due to the cable weight, including the chain. This lengthening due to sagging must be monitored at regular intervals and adjusted if necessary.

12.5 Wiring of robot area »SuperhighFlex Quality«

In order to achieve an optimal service life of cables in robotics applications, comply with the following points when laying the cables:

- ➔ Avoid using cable binders to fasten cables.
- ➔ Lay the cable duct so that the cables have maximum freedom of movement.
- ➔ Lay the cables so that the sleeves do not rub during operation.
  Cables should not knock against static parts or hang loose.
- ➔ Cables should not shift during operation.
- ➔ Do not exceed the minimum specified bending radii.
  The size of the bending radius is proportional to length of the service life.
- ➔ Make sure that the length of the cable compensates for torsional loads.

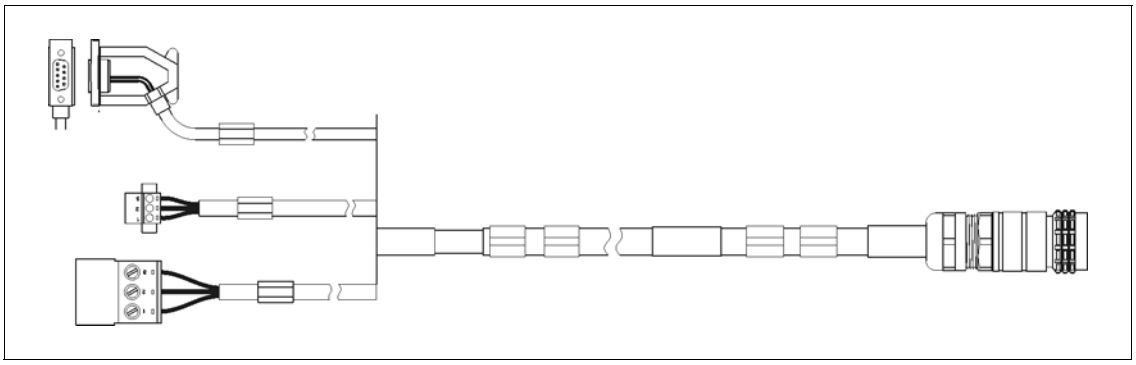
13 Cable

13.1 HighFlex Quality, suitable for cable ducts

Thermal properties		
Ambient temperature	°C	-20…+80
Flammability		Flame-retardant and self-extinguishing in accordance with EN 50265-2-1, IEC 60332-1 and UL1581
Chemical properties of the coating		
Coating material		PUR, low-adhesion, resistant to hydrolysis and microbes, UV-resistant, abrasion-resistant, tear-resistant, cut-resistant, notch-resistant
Oil resistance		Oil-resistant in accordance with DIN VDE 0472, part 803 ASTM oil 1 to 3 and HD 505.2.1
Resistance to hydrolysis		In accordance with VDE 0283, part 10
Color		RAL 2003 matt
Mechanical properties		
Diameter	mm	approx. 13,8
Bending radii: **Single bends** **Multiple bends**	**mm**	 **30 min.** **95 mm min. flexing action** **130 min alternate bending**
Torsional length (±180 ° around separate central axis)	**mm**	**500 min.**
Max. acceleration	m/s²	100

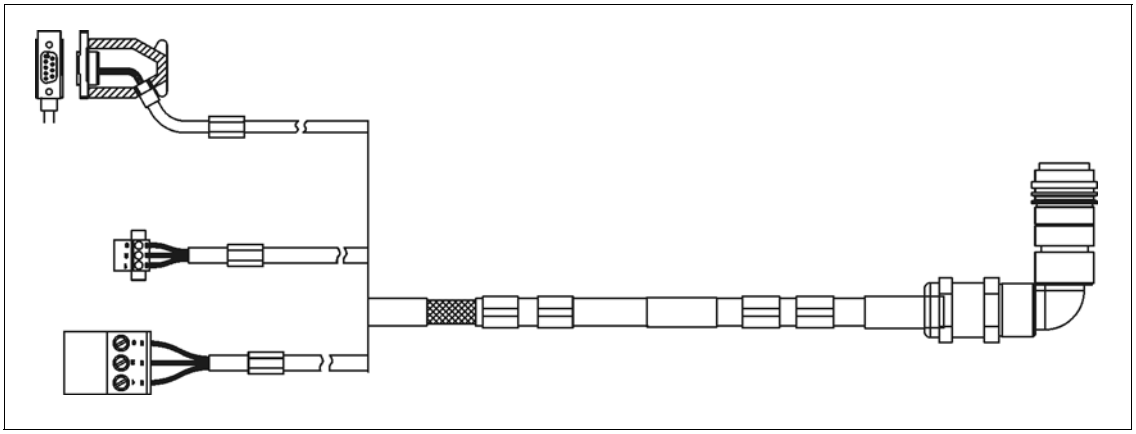
13.1.1 System cable, type C

Use	Nutrunner control unit – DGD-IS
Order No.	961109-××× (…-××× = cable length in dm)



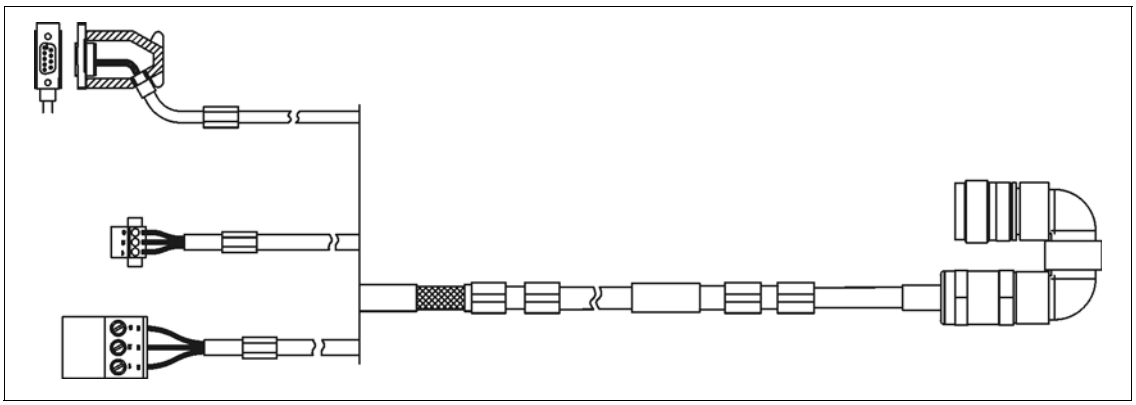
13.1.2 System cable, type I

Use	Nutrunner control unit – DGD-IS
Order No.	961294-××× (…-××× = cable length in dm)



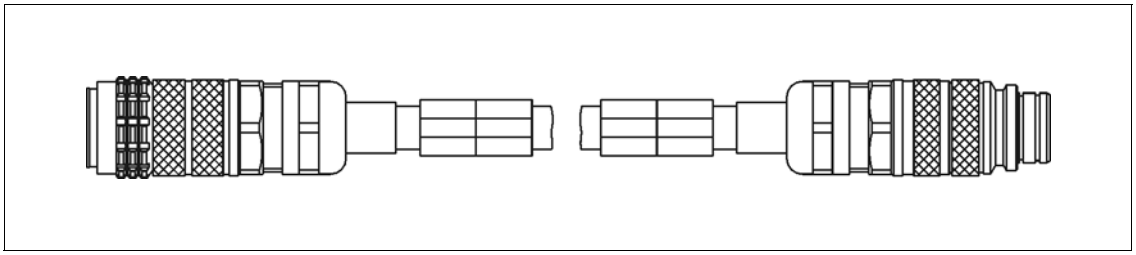
13.1.3 System cable, type J

Use	Nutrunner control unit – DGD-IS
Order No.	961289-××× (…-××× = cable length in dm)



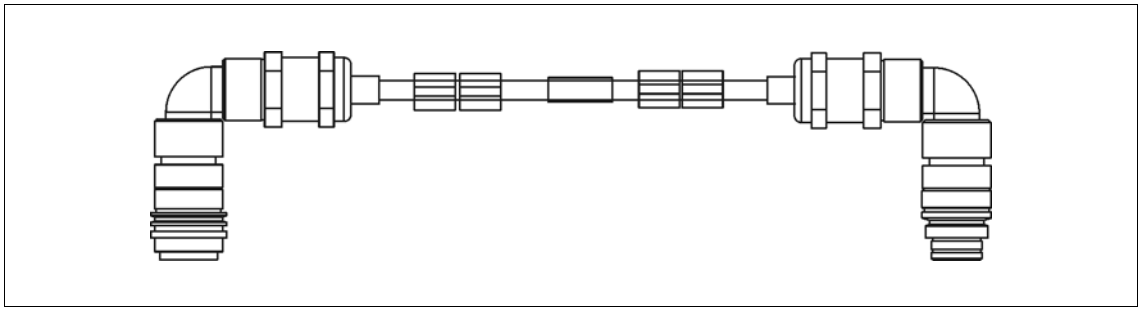
13.1.4 System cable, type A

Use	Intermediate plug position – DGD-IS
Order No.	961104-××× (…-××× = cable length in dm)



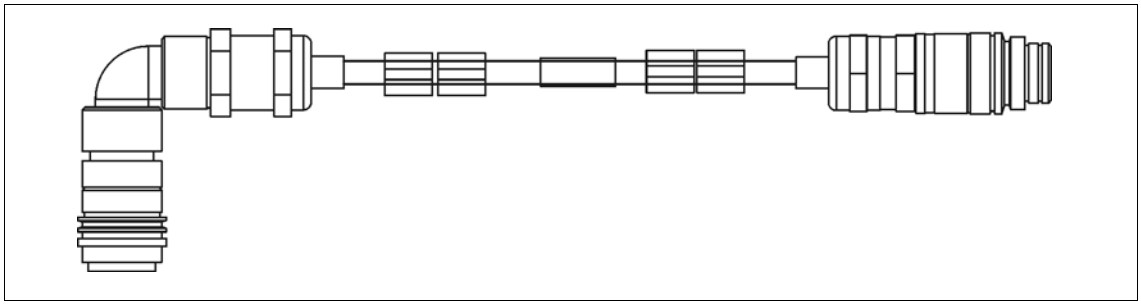
13.1.5 Jumper cable, type E

Use	DGD-IS – DGD-IS
Order No.	961299-××× (…-××× = cable length in dm)



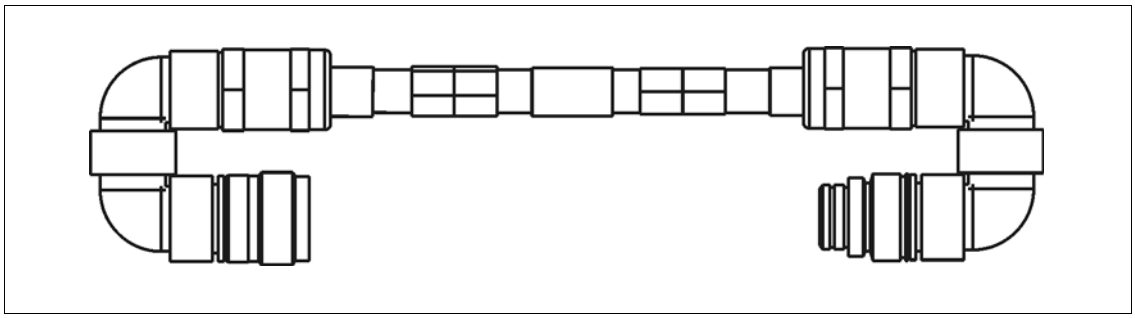
13.1.6 Jumper cable, type F

Use	DGD-IS – DGD-IS
Order No.	961295-××× (…-××× = cable length in dm)



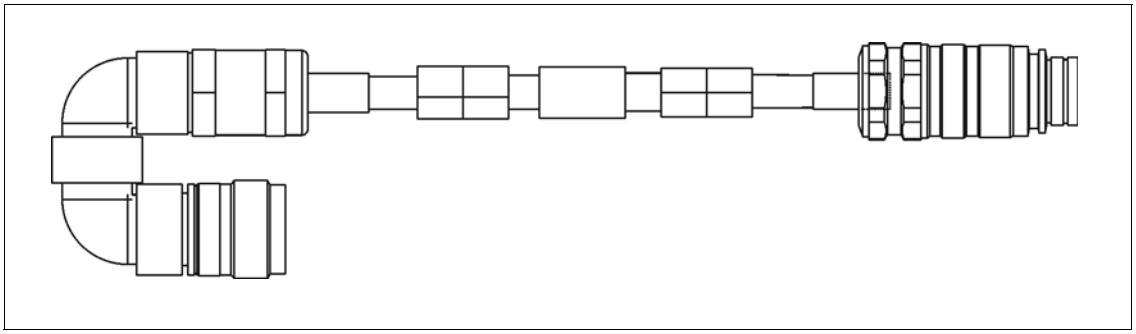
13.1.7 Jumper cable, type G

Use	DGD-IS – DGD-IS
Order No.	961298--××× (…-××× = cable length in dm)



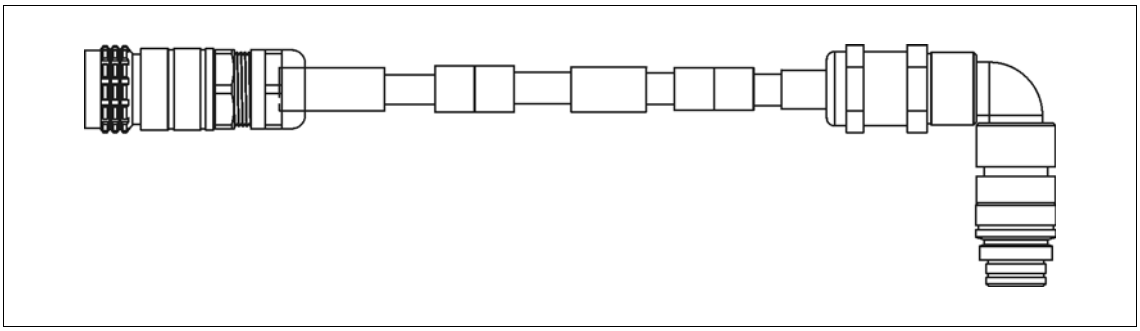
13.1.8 Jumper cable, type H

Use	DGD-IS – DGD-IS
Order No.	961297--××× (…-××× = cable length in dm)



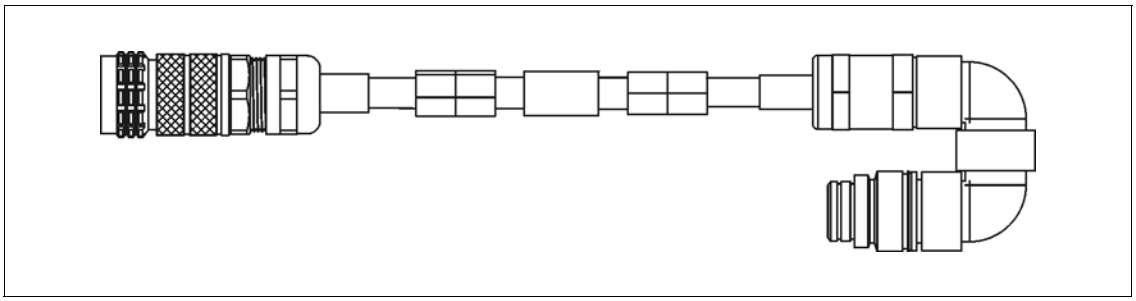
13.1.9 Jumper cable, type K

Use	DGD-IS – DGD-IS
Order No.	961292-××× (…-××× = cable length in dm)



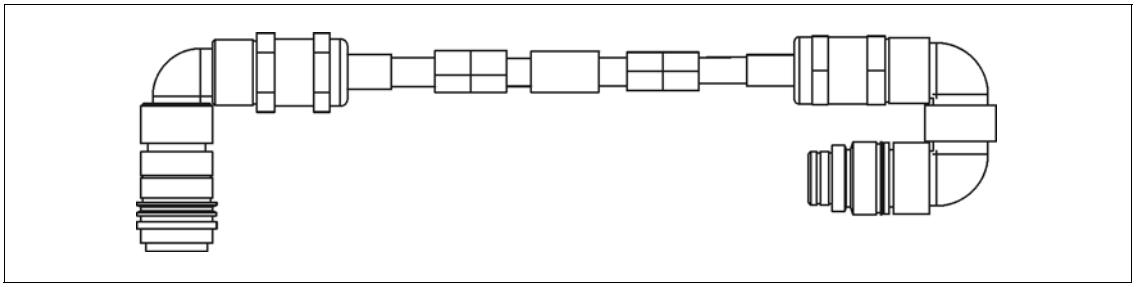
13.1.10 Jumper cable, type L

Use	DGD-IS – DGD-IS
Order No.	961293--××× (…-××× = cable length in dm)

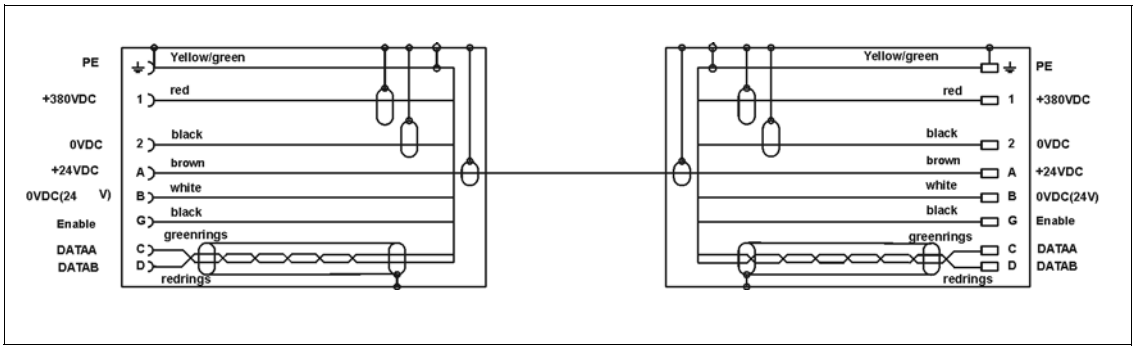


13.1.11 Jumper cable, type M

Use	DGD-IS – DGD-IS
Order No.	961296--××× (…-××× = cable length in dm)



13.1.12 Wiring diagram

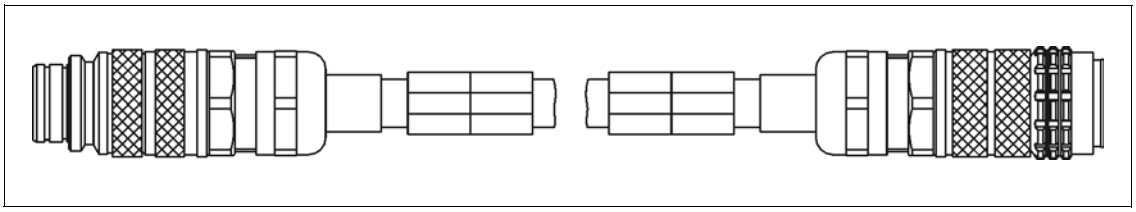


13.2 Super Highflex, suitable for robots

Thermal properties		
Ambient temperature	°C	-20…+90
Flammability		Flame-retardant and self-extinguishing in accordance with EN 50265-2-1, IEC 60332-1 and UL1581
Chemical properties of the coating		
Coating material		PUR, low-adhesion, resistant to hydrolysis and microbes, UV-resistant, abrasion-resistant, tear-resistant, cut-resistant, notch-resistant
Oil resistance		Oil-resistant in accordance with DIN VDE 0472, part 803 ASTM oil 1 to 3 and HD 505.2.1
Resistance to hydrolysis		In accordance with VDE 0283, part 10
Color		Orange RAL 2003 matt
Mechanical properties		
Diameter	mm	approx. 14
Bending radii: **Single bends** **Multiple bends**	**mm**	 **30 min.** **60 mm min. flexing action** **43 min alternate bending**
Torsional length (±180 ° around separate central axis)	**mm**	**500 min.**
Max. acceleration	m/s²	100

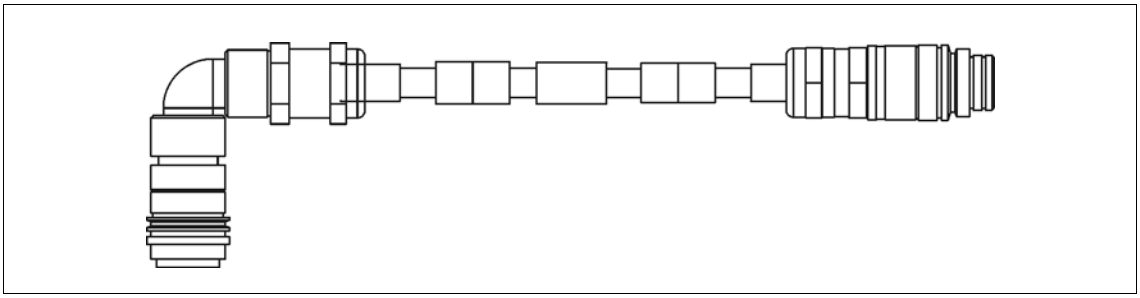
13.2.1 System cable, type A

Use	Intermediate plug position – DGD-IS
Order No.	961103-××× (…-××× = cable length in dm)



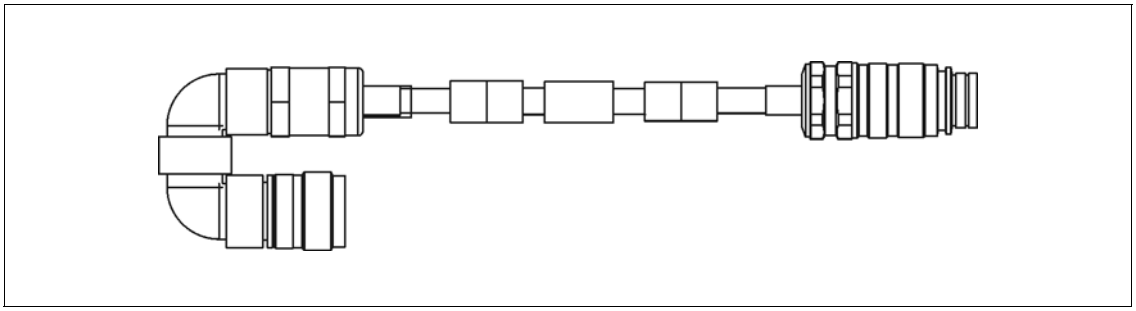
13.2.2 Jumper cable, type F

Use	DGD-IS – DGD-IS
Order No.	961395-××× (…-××× = cable length in dm)

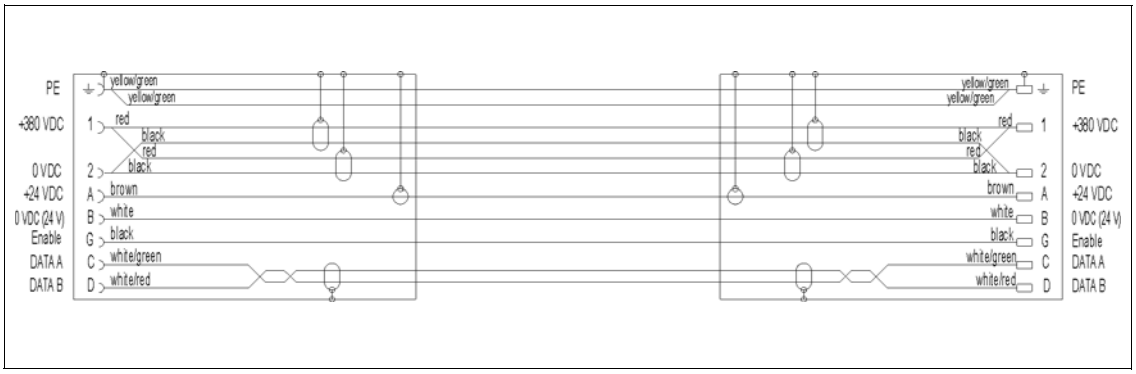


13.2.3 Jumper cable, type H

Use	DGD-IS – DGD-IS
Order No.	961397--××× (…-××× = cable length in dm)



13.2.4 Wiring diagram



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14 Function description

14.1 Torque measurement

The transducer is equipped with a telemetry system and therefore has no slip rings.
The transducer is either installed in the DGD-IS as a component or integrated in an offset attachment or angle head attachment.
All components of the transducer (measuring shaft, antenna system, rotor electronics and stator electronics) belong together as one unit, i.e. individual assemblies cannot be replaced.
The rotor electronics are attached to the measuring shaft and are connected to the full strain gage bridge and the rotor antenna system.
The stator electronics are located in the transducer housing. They incorporate the evaluation circuit, the stator antenna system and the 12-pin system connector.
The torque and the angle are measured directly at the attachment. Exception: the angle of the angle head attachment is measured at the drive wheel.
Torque measurement is made symmetrically for right and left-rotating torques (tightening and loosening direction).
The measured torque values are transferred from the transducer to the measuring electronics via an amplified analog voltage (0...±5 V).

NOTE

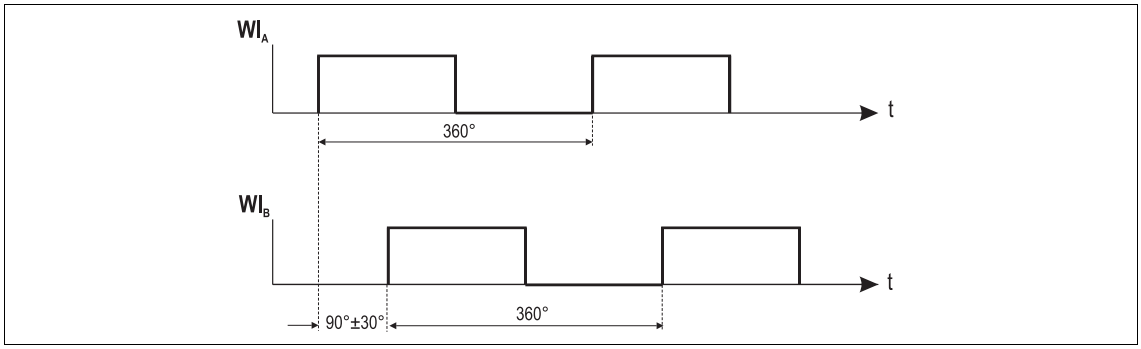
Always use measuring devices that are galvanically isolated from the protective earth conductor for measuring the torque / angle encoder signals directly on the transducer (e.g. oscilloscope with isolation transformer). When measuring, ensure that both 0 V reference connections of the transducer (0 V-torque/Pin D and 0 V-supply/Pin E) cannot be short-circuited.
Ignoring this may result in failures or measuring errors from potential equalization currents (between PE, 0 V TQ and 0 V supply) in the torque measurement circuit.

Calibration takes places in the rotor unit by means of a switched shunt resistor parallel to a strain gage measuring bridge section.
The calibration signal has the following time behavior:

Input pulse duration (pin K)	Output signal delay (pin C)
0...1.5 ms	No output signal
1.5 ms...random	Max. rise delay < 3 ms Max. drop delay < 16 ms

14.2 Angle measurement

The integrated incremental angle encoder traces the angle with two angle tracks (WI). The phase shift between these depends on the sense of rotation. The angle signals are read by query of the 360 magnetic poles of the pole wheel and are then transferred to the measuring electronics at amplified output voltage/ voltage increase of 12 V.



14.3 Redundant design of a sensor system (according to VDI 2862)

NOTE

If the transducer is used in conjunction with an offset or angle head attachment, the calibration data must be taken into consideration accordingly

14.3.1 Torque measurement calibration

The dispersion of efficiency linked to manufacturing requires the inclusion of a calibration factor. This can only be determined by additional measuring systems and is defined as a calibration factor (mk).

Example:

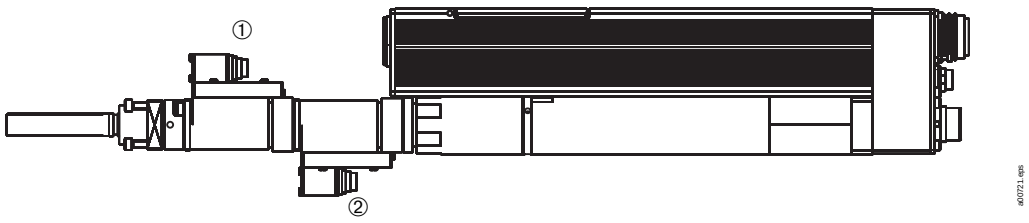
DGD-IS with transducer 1K3B
Offset attachment 1VK3B
Specified calibration factor mk = 1.035[1)]
Rated torque = 12 Nm at 5 VDC

Corrected calibration value
Rated torque x mk
-> 12 Nm x 1.035 = 12.42 Nm

14.3.2 Angle measurement calibration

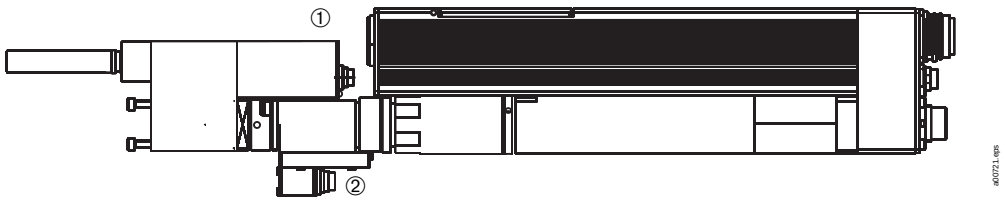
The transmission ratio also causes the angle measurement to change; it is corrected with the angle calibration factor (W).
The angle calibration factor corresponds to the transmission ratio (8 Transducer, Seite 38).

Example of a DGD-IS standard



Centric version	
1BTS-1B012A-2/1K3B-1ZB	Order no. 947542A7
Serial no.	0550815
Speed:	1921 RPM
Torque:	max. 12 Nm
Cal TQ1:	12 Nm, 5V DC
Cal TQ2:	12 Nm, 5V DC
Angle calibration	A①: 1.000 ¹ degrees
Angle calibration	A②: 1.000 ¹ degrees
Voltage:	380 V DC

1) is calculated using attachment transducer and test case MPK (see system description 3.1 Components, Seite 9)



Offset version	
1BTS-1B012A-1K3B-1VK3B	Order no. 947544A5
Serial no.	0550816
Speed:	1824 RPM
Torque:	max. 12 Nm
Cal TQ1:	12 Nm, 5V DC
Cal TQ2:	12 Nm x mk 5V DC
Angle calibration	A①: 1.000 ¹ degrees
Angle calibration	A②: 1.053 ¹ degrees
Voltage:	380 V DC

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15 Troubleshooting

The following displays will help you to troubleshoot

- Nutsetter control unit m-Pro-400S-CPM…
- Supply module CPS3 (in m-Pro-400S-CPM…)
- Tightening module TS/TUS (on DGD-IS) .

DANGER! High leakage current –
Fatal electric shock could occur!
Always disconnect the system cable, motor or motor cable from the m-Pro-400S-CPM… or DGD-IS before making throughput, resistance and short circuit measurements.

NOTE

- Always replace CPS3 and TS/TUS completely.
- Opening the CPS3 or TS/TUS will void the warranty. This does not include the service panel.
- Observe the conditions for operation, see 4 Initial operation, Seite 11.

15.1 Acknowledgment of Errors

The system is ready for operation again once the fault is rectified and the <Reset> button on the CPS3 or TS/TUS is pressed.
The measuring board acknowledges faults pending in the TS/TUS each time a spindle starts.
If the failure is brief (e.g. undervoltage), the TS/TUS becomes ready to operate automatically after the next acknowledgment signal.
All faults on the DGD-IS (not from CPS3) are archived in the station controller. The error information is displayed here during troubleshooting.
The error is permanent if the error mode cannot be acknowledged.

15.2 DGD-IS

Error Description	Possible causes	Measures and remedies
DGD-IS does not turn	Motor defective Gearing defective Tightening module TS/TUS defective	➔ Replace the DGD-IS
	Cable defective	➔ Replace the cable
Loud noises	Gearing wear	➔ Replace the DGD-IS

15.2.1 Transducer

When an operating failure occurs, the torque output is set to an output value of >6.5 V and an error bit is set in the operating data memory.

Error Description	Possible causes	Measures and remedies
Output signal is not linear	Measuring hub was over-stretched	➔ Send the transducer to Sales & Service Center for repair / recalibration
Offset voltage is too high	Measuring hub was over-stretched	
No output signal	Pre-amplifier is defective	
Torque output is set to an output value > 6.5 V **Error bit is set in the operating data memory**	**CPU NOK** • internal transmission to D/A converter fails	
	HF section NOK • HF telemetry transmission fails • no measuring shaft (rotor) present • rotor electronics defective • gap between rotor and stator antenna too large	
	Supply voltage NOK • voltage under low supply voltage limit	

After an operation error, the transducer remains in the "operation error" state until one of the following events occurs:

- the operating voltage of the transducer is disconnected
- the transducer receives a calibration signal via the CAL input (pin K).
- the error bit in the operating memory is reset via the RS422 interface.

15.3 Tightening module CPS3 in nutsetter control unit m-Pro-400S-CPM…

15.3.1 "Ready" LED

Error Description	**Possible causes**	**Measures and remedies**
"Ready" LED does not light up	24 V supply is unavailable	➔ Check the 26 V voltage at "XS3" terminals 1 and 4
	m-Pro-400S-CPM… is disconnected from the power supply	➔ Check the mains supply
	24 V power adapter is disconnected from the power supply	➔ Check the fuse
	Fuse in the CPS3 is high-resistance	➔ Check the 26 V voltage at "XS4" terminals 1 and 4 ➔ Switch off the m-Pro-400S-CPM… and switch back on again after a minute. ➔ Replace the CPS3

15.3.2 "EM stop" LED (emergency stop)

Error Description	**Possible causes**	**Measures and remedies**
"EM stop" lights up CPS3 is in *Emergency stop* status.	Intermediate power circuit (380 VDC) is deactivated. No signals at the emergency stop inputs "XS4", terminal 2 or Control on "XS5", terminals 3 and 4.	➔ Check the 24 V voltage on the CPS3: Plug connector "XS4" terminals 2 and 4; Plug connector "XS5" terminals 3 and 4 ➔ Check the 24 V voltage on PM: Plug connector "XS3" terminals 2 and 6; Plug connector "XS2" terminals 5 and 6 Fact: the signals are not generated by external controls.

15.3.3 7-segment "Status" display

Encoded errors are displayed in a 7-segment display on the CPS3. The display alternates between the first and second digit at brief intervals:

Display	Duration	Pause
1st digit	0.5 s	0.2 s
2nd digit	0.5 s	1 s
1st digit	0.5 s	0.2 s etc.

A period (.) in the display means NO error.

If several errors occur, the error with the highest priority is displayed, i.e. with the lowest number.

The errors or faults that the CPS3 detects are NOT communicated to the station controller via ARCNET and then displayed on the screen.

Display	Error Description	Possible causes	Measures and remedies
0-0	**Error loading the intermediate circuit capacitors after switching on**	Short circuit in the intermediate circuit CPS3	➔ Replace the CPS3
		• Cables	➔ Check the cables for short circuiting between contacts 1 and 2 on the plug connectors and replace if necessary
		• TS/TUS	➔ Replace the TS/TUS
		• Main relay (Q4 or Q5 in PM) does not switch	➔ Check the main relay, replace if necessary
0-1	**Faulty supply 3 x 270 VAC**	Phases missing	➔ Check phases ➔ Check mains supply
		Safety relay PNOZ K2 in the power module has triggered an *emergency stop*	➔ Check the *emergency stop* circuit ➔ Read the operating instructions for the PNOZ type X3P
		Relay Q2 or Q3 has not switched	➔ Check the relay, replace if necessary
		Supply voltage • is too high, U phase – phase > 300 VAC • too low, U phase – phase < 240 VAC	➔ Check the supply voltage ➔ Check mains supply
0-2	**Excess current or short circuit on braking chopper**	Braking current > 200 A: Short circuit in the braking resistor	➔ Replace the CPS3
0-4	**Braking chopper overload**	Braking resistor is overloaded. The braking power is > 100 $W_{eff.}$ Excessive number of DGD-IS.	➔ Reduce the number of m-Pro-400S-CPM…
			DGD-IS is powered externally ➔ Check the mechanics of the fastening station

Display	Error Description	Possible causes	Measures and remedies
1-1	**Excessive voltage between artificial neutral point of the power supply and PE or the center of the intermediate circuit (approx. 190 VDC) and PE** Voltage >100 V	Short circuit between IC and PE:	➔ Check connection of intermediate circuit voltage +380 VDC and 0 VDC to PE
		• CPS3	➔ Check CPS3 replace if necessary
		• System cable	➔ Replace the system cable
		• TS/TUS	➔ Replace the TS/TUS
		• Motor	➔ Replace the motor or DGD-IS
1-2	**Excessive current or short circuit in the intermediate circuit** Current >250 A		Check the system cable between the +380 VDC and 0 V wires for short circuiting
		• System cable short circuit	➔ Replace the cable
		• Short circuit TS/TUS	➔ Replace the TS/TUS
1-3	**Temperature of the cooling element is too high** CPS3 temperature, cooling element is >90 °C	Constant overload CPS3	Excessive number of DGD-IS. ➔ Reduce the number of m-Pro-400S-CPM…
		Ambient temperature m-Pro-400S-CPM… >40 °C	➔ Improve the ambient conditions
		m-Pro-400S-CPM… is exposed to other heat sources, e.g. sunlight	➔ Improve the ambient conditions, attach covers if necessary
		Heat dissipation from the m-Pro-400S-CPM… is inadequate due to external conditions	➔ Ensure that air can circulate through the cooling fins
1-4	**I^2t Error in intermediate circuit** The intermediate circuit is overloaded.	Excessive number of DGD-IS.	➔ Reduce the number of m-Pro-400S-CPM…
1-6	**The intermediate circuit voltage is too high** Intermediate circuit voltage 480 VDC May also occur momentarily	Braking chopper is defective	➔ Replace the CPS3
		Excessive number of DGD-IS is causing the braking chopper to overload	➔ Reduce the number of m-Pro-400S-CPM…
		Intermediate circuit capacitors no longer have sufficient capacity	Life span exceeded ➔ Replace CPS3

Display	Error Description	Possible causes	Measures and remedies
1-7	**Intermediate circuit voltage is too low** Intermediate circuit voltage <250 VDC	Mains supply is not powerful enough	Check the mains supply ➔ More powerful mains supply required
		Relay to the switch-on current limiter is defective and permanently open	➔ Replace the CPS3
		Excessive number of DGD-IS. The voltage drops during fastening	➔ Reduce the number of m-Pro-400S-CPM…
2-0	**Temperature in CPS3 is too high or too low** Temperature is outside of the -40 °C to +85 °C range	Excessive number of DGD-IS. Constant overload of the CPS3	➔ Reduce the number of m-Pro-400S-CPM…
		Ambient temperature m-Pro-400S-CPM… >40 °C	➔ Improve the ambient conditions
		m-Pro-400S-CPM… is exposed to other heat sources, e.g. sunlight	➔ Improve the ambient conditions, attach covers if necessary
		Heat dissipation from the m-Pro-400S-CPM… is inadequate due to external conditions	➔ Ensure that air can circulate through the cooling fins
		Housing openings on the CPS3 are covered	➔ Clear the housing openings
2-1	**Switch-on relay contact does not open** Relay for switch-on current limitation in the CPS3 is stuck. Detection only occurs when switching on. The relay contact is closed during operation	Subsequent error – a different fault destroyed the relay	➔ Replace the CPS3
		Maximum number of switch-on cycles exceeded	➔ Replace the CPS3
2-2	**Intermediate circuit (380 VDC) discharge not possible** The intermediate circuit cannot be discharged	Subsequent error, a different fault destroyed the relay	
		Main relay Q4 or Q5 in PM does not open	➔ Replace the main relay Q4 or Q5
		Braking chopper in the CPS3 is defective	➔ Replace the CPS3
		Braking resistor is highly resistive or burnt through	➔ Replace the CPS3

Display	Error Description	Possible causes	Measures and remedies
2-3	**24V supply** 24 V supply is not within the range 21.5 V - 27.3 V		➔ Measure the voltage at "XS3", terminals 1 and 6
		24 V power adapter in m-Pro-400S-CPM… is defective	➔ Replace the power adapter
		Power adapter T2 in m-Pro-400S-CPM… is overloaded	➔ Check the maximum load (8 A) on the CPS3
		Voltage on power adapter in m-Pro-400S-CPM… is incorrect	➔ Set the voltage on the power adapter to 26.0 V
		Fuse (thermal) 24 V in the CPS3 is highly resistive	➔ Switch off the m-Pro-400S-CPM… and switch back on again after a minute. ➔ Check the maximum load – replace the CPS3
2-5	**5 V supply (internal)** Internal 5 V supply is not within the 4.5 V – 5.5 V range	Internal voltage, external check not possible	
		Power adapter in the CPS3 is defective	➔ Replace the CPS3
		Power adapter in the CPS3 is overloaded	➔ Replace the CPS3
2-7	**Error in 15 V driver supply for the braking chopper**	The internal 15 V supply is <12.5 V	Internal voltage can not be checked externally
		Power adapter in the CPS3 is defective	➔ Replace the CPS3
		Power adapter in the CPS3 is overloaded	➔ Replace the CPS3
3-3	**Initialization or program error**	Internal program error, no external actions possible	
		Error during program initialization	➔ Inform Sales & Service Center ➔ Switch the m-Pro-400S-CPM… off and on again
		Communication error with a service PC	➔ Reconnect PC to CPS3
		Checksum error	➔ Inform Sales & Service Center ➔ Switch the m-Pro-400S-CPM… off and on again

15.4 Tightening module TS/TUS

15.4.1 "Ready" LED

Error Description	**Possible causes**	**Measures and remedies**
"Ready" LED lights up red	Error in the TS/TUS	Error description on the station controller display, see 15.5 Station controller m-Pro-400S, S. 76
"Ready" LED does not light up	24 V supply is unavailable, the TS/TUS is not connected to the power supply	➔ Measure the voltage 24 – 26 V at "XS1B", sockets A and B ➔ Check the error display on the CPS3 of m-Pro-400S-CPM…. ➔ If error present, go to 15.3 Tightening module CPS3 in nutsetter control unit m-Pro-400S-CPM…, Seite 71 ➔ Replace the system cable
	TS/TUS is defective	➔ Replace TS/TUS

15.5 Station controller m-Pro-400S

15.5.1 Display on the Control Unit

The errors or faults that the TS/TUS fastening electronics detect are communicated to the station controller via ARCNET and then displayed on the screen.
If an error occurs in the TS/TUS or DGD-IS during fastening, the error reported by the TS/TUS appears in the rundown data table:
IP, FLT, FMK, FHW, KAL1, KAL2, OFF1, OFF2, VAP, VLP, AN1F, AN2F, WG1D, WG2D
(see also operator information "Nutsetter control unit m-Pro-400S").
The *Error log* window opens with a description of the error that has occurred.

The *System information* window appears in the *ARCNET Map* window (see operator information m-Pro-400S). All current errors are displayed here in descriptive text and listed in the following table.

All errors are logged in the *Logbook* (see operator information m-Pro-400S) for the m-Pro-400S and can be viewed at a later time.

Error Description	**Possible causes**	**Measures and remedies**
Servo: **IP monitoring: NOK** (also displayed in the rundown data table) Overload If a current higher than the maximum permissible current is required for fastening, the servo amplifier switches off automatically.	Error in motor position tracing, e.g. resolver cable	Check the resolver wires in the nutsetter cable ➔ Replace the nutsetter cable and check the resolver wires in the nutsetter cable for breaks ➔ Replace the DGD-IS or the motor
	Error in the motor circuit, e.g. motor does not attain the required torque	➔ Check the motor against PE and phase impedances for short circuits: 1BT… approx. 11 Ω, 2BT approx. 2 Ω, 3/4BT… approx. 0.6 W. ➔ Replace motor
	Incorrect programming	➔ Check programming in the station controller – Spindle constants – Calibration values – Fastening process (sequence) – Parameter set – Targets
Servo: **Intermediate circuit voltage: too high** The voltage in the intermediate power circuit is > 440 VDC	Constant error	See CPS3 troubleshooting – no error on CPS3 ➔ Replace the TS/TUS
	The error is triggered during braking, i. e. when the DGD-IS stops	See CPS3 troubleshooting – no error on CPS3 ➔ Replace the TS/TUS
	Sporadically, the voltage is temporarily too high	See CPS3 troubleshooting – no error on CPS3 ➔ Replace the TS/TUS
Servo: **Intermediate circuit voltage: too low** The voltage in the intermediate power circuit is < 190 VDC	Constant error	See CPS3 troubleshooting – no error on CPS3 ➔ Check the system cable for interruptions ➔ Replace the system cable System cable OK ➔ Replace the TS/TUS
	During fastening, error is triggered during the fastening process	See CPS3 troubleshooting – no error on CPS3 ➔ Replace the TS/TUS
	Sporadically, the voltage is temporarily too low	See CPS3 troubleshooting – no error on CPS3 ➔ Check the mains power supply for voltage drops

Error Description	**Possible causes**	**Measures and remedies**
Servo: **Temperature output section: too high** The temperature in the TS/TUS output section is > 80 °C	The temperature sensor in the TS/TUS measures a temperature > 80 °C	Check temperature if > 80 °C ➔ ensure adequate ventilation of the DGD-IS DGD-IS is ventilated sufficiently ➔ Replace the TS/TUS
Servo: **Driver supply outp. section: NOK** The power adapter for the internal supply to the output section is overloaded or defective.	Internal error	➔ Replace the TS/TUS
Servo: **Offset of current measurement: NOK** The zero point of the integrated motor current measurement has moved	Internal error	➔ Replace the TS/TUS
Servo: **SSIO communication: NOK** The communication interface between the servo amplifier and the measuring board is faulty	Internal error	➔ Replace the TS/TUS
Servo: **Node guarding: NOK** The servo amplifier monitors the function of the measuring board (watchdog).	Sporadic malfunction of the measuring board Internal error	➔ Replace the TS/TUS
Servo: **Flash: NOK** The flash memory in the servo amplifier indicates an error	Internal error	➔ Replace the TS/TUS
Servo: **Program: NOK** Error in the program execution for the servo amplifier	Internal error	➔ Replace the TS/TUS ➔ Inform Sales & Service Center
Motor: **Motor cable: NOK** The motor cable is defective, motor wire in DGD-IS is broken	Broken motor wire in the nutsetter cable	Check the motor wires for breaks and short circuits ➔ Replace the nutsetter cable
	Motor phases interrupted	➔ Check the motor against PE and phase impedances for short circuits: 1BT… approx. 11 Ω, 2BT approx. 2 Ω, 3/4BT… approx. 0.6 W. ➔ Replace motor
	Test current for cable monitoring is misdirected	➔ Replace motor Internal error ➔ Replace the TS/TUS

Error Description	**Possible causes**	**Measures and remedies**
Motor: **Short circuit surveillance: NOK** Motor short circuit monitoring There is a short circuit in the motor circuit on the DGD-IS	In the cable	Check the motor wires in the nutsetter cable for short circuits ➔ Replace the cable
	in the motor	Check the motor for short circuits (for phase impedances, see above) ➔ Replace motor
	In the TS/TUS	Internal error ➔ Replace the TS/TUS
Motor: **Temperature: NOK** The motor temperature is > 90 °C	The temperature sensor in the motor measures a temperature > 90 °C	Check the motor temperature, if > 90 °C ➔ ensure adequate ventilation of the motor
	Measuring cable in the motor is interrupted	Check the thermosensor for breaks. The resistance should be approx. 1 KΩ at 20 °C ➔ Replace motor
	Measuring current is misdirected	Check the wires in the DGD-IS for breaks and short circuits ➔ Replace motor
	Measuring current is not measured	Internal error, ➔ Replace the TS/TUS
	Motor is not connected	➔ Connect the motor
Motor: **I^2t monitor: NOK** The I^2t monitor has measured excessive power on the DGD-IS	Motor power required is too high	Check the motor temperature, if > 80 °C ➔ Shorten the fastening time by increasing the speed
	DGD-IS is defective (e.g. gearing, bearings)	Check the ease of movement of the gearing and motor on the DGD-IS ➔ Replace the DGD-IS or motor
Motor: **Resolver: NOK** No resolver signals measured	Signals are not present	Check whether the motor is connected ➔ Connect the motor
	Signal interruption	Check the resolver wires in the DGD-IS ➔ Replace motor
	Short circuit of signals	Check the resolver wires in the DGD-IS for short circuits ➔ Replace motor
	Supply to the resolver is defective	Internal defect ➔ Replace the TS/TUS
Measurement card: **Task monitoring: NOK** Error at the program execution end of the measuring board	Internal error	➔ Replace the TS/TUS ➔ Inform Sales & Service Center

Error Description	**Possible causes**	**Measures and remedies**
Measurement card: **RAM:** Insufficient RAM available in the measuring board	Internal error	➔ Replace the TS/TUS ➔ Inform Sales & Service Center
Measurement card: **Sampling clock from servo: NOK** The system clock from the servo amplifier is missing	Internal error	➔ Replace the TS/TUS
Measurement card: **Servo type correct: NOK** The selected servo amplifier type is incorrect	Error in programming	➔ Check the system programming
	Self-identification of transducer is not OK	Check the transducer ➔ Replace the transducer
	Internal error	➔ Replace the TS/TUS
Measurement card: **Servo par. matching servo: NOK** The parameter set selected from the measuring board is not present in the TS/TUS.	Error in programming	➔ Check the system programming
	Self-identification of transducer is not OK	Check the transducer ➔ Replace the transducer
	Internal error	➔ Replace the TS/TUS
Measurement card: **ARCNET communication:** **Dup ID** The same ARCNET addresses are preset	Several TS/TUS are preset to the same ARCNET address	Check the preset ARCNET addresses ➔ Set different addresses
Measurement card: **ARCNET communication:** **Recon** The ARCNET is temporarily disrupted	ARCNET terminator missing	➔ Plug in the ARCNET terminator
	No power supply to the ARCNET terminator	➔ Switch on the power supply for the last device
	Error in cabling	➔ Plug in all cables and lock
	Error in potential equalization	➔ Connect potential equalization cable
	Internal error	➔ Replace the TS/TUS
Measurement card: **Initialization: NOK** Initialization error in measuring board	Internal error	➔ Replace the TS/TUS ➔ Inform Sales & Service Center
Measurement card: **Flash image: NOK** Flash image in the measuring board is not OK	Station controller transferred the incorrect program	➔ Check the program version
	The program transfer was interrupted	➔ Repeat the program transfer
	Internal error	➔ Replace the TS/TUS

Error Description	**Possible causes**	**Measures and remedies**
Measurement card: **Voltage +3.3 V (…): NOK** The +3.3 V supply to the measuring board is outside the limits of +3.24 V... +3.53 V	The power adapter for the internal supply to the measuring board is overloaded or has an internal error.	➔ Replace the TS/TUS
Measurement card: **Voltage +12 V (…): NOK** The +12 V supply to the measuring board and the transducer is outside the limits of +11.4 V... +12.6 V	+12 V short circuiting in the nutsetter cable or DGD-IS	Inspection of station controller in test mode – value outside the permissible limits: Check the KMAG/KMAW cable (transducer – TS/TUS), especially the +12 V and 0 V wires. ➔ Replace the cable ➔ Replace the transducer or DGD-IS
	Internal power adapter defective	➔ Replace the TS/TUS
Measurement card: **Voltage +24 V (…): NOK** The +24 V supply of the TS/TUS is outside the limits of +20.4 V…+27.6 V	Supply is overloaded	Inspection of station controller in test mode – value outside the permissible limits: ➔ Check the load
	Voltage on power adapter in m-Pro-400S-CPM… is incorrect	➔ Set the power adapter to 26.0 V
Measurement card: **Temperature (…): NOK** The temperature of the measuring board is > 80 °C	The temperature sensor in the TS/TUS measures a temperature > 80 °C	➔ ensure adequate ventilation of the DGD-IS
	Internal error	DGD-IS is ventilated sufficiently ➔ Replace the DGD-IS
Transducer 1 / 2: **…Connected: NOK** The signals from the transducer are not OK	The connection to the transducer is – interrupted	Check the KMAG/KMAW cable (transducer – TS/TUS) for breaks ➔ Replace the cable ➔ Replace the transducer
	– short-circuited	Check the KMAG/KMAW cable for short circuits ➔ Replace the cable ➔ Replace the transducer
	– unavailable	➔ Connect the transducer ➔ Replace the cable
	Internal error	➔ Replace the TS/TUS
Transducer 1 / 2: **Calibration voltage: NOK** The calibration voltage is outside the permissible range of +4.85 V...+5.15 V	The calibration signal is interrupted	➔ Check the KMAG/KMAW cable for breaks, especially the calibration signal wire
	The calibration signal is short circuiting with another signal	Check the KMAG/KMAW cable (transducer – TS/TUS) for short circuits ➔ Replace the cable
	Error in the transducer	➔ Replace the transducer
	Internal error	➔ Replace the TS/TUS

Error Description	**Possible causes**	**Measures and remedies**
Transducer 1 / 2: **Offset value: NOK** The zero-point voltage is outside the permissible range of -200 mV...+200 mV	The torque signal is interrupted	Inspection of station controller in test mode – value outside the permissible limits: Check the KMAG/KMAW cable (transducer – TS/TUS) for breaks ➔ Replace the cable
	The torque signal is short circuiting with another signal	Check the KMAG/KMAW cable (transducer – TS/TUS) for short circuits ➔ Replace the cable
	Error in the transducer	➔ Replace the transducer
	Internal error	➔ Replace the TS/TUS
Transducer 1 / 2: **Angle encoder: NOK** The angle signals are disrupted	One or both angle signals is / are – interrupted	Check the KMAG/KMAW cable (transducer – TS/TUS) for breaks, especially the angle signal wires ➔ Replace the cable
	– short circuiting with another signal	Check the KMAG/KMAW cable (transducer – TS/TUS) for short circuits ➔ Replace the nutsetter cable
	– temporarily unavailable Error in the transducer	➔ Replace the transducer
	Internal error	➔ Replace the TS/TUS
Transducer 1 / 2: **CRC of service memory: NOK** Could not read in the data for self-identification correctly	The data cables are – interrupted	Check the KMAG/KMAW cable (transducer – TS/TUS) for breaks, especially the signal wires for data transfer (RS422) ➔ Replace the cable
	– short circuiting with another signal	Check the KMAG/KMAW cable (transducer – TS/TUS) for short circuits ➔ Replace the cable
	Error in the transducer	➔ Replace the transducer
	Communication was disrupted when the transducer was plugged in	➔ Unplug and plug in again
Transducer 1 / 2: **Tool identification: NOK** Station controller does not confirm the data for self-identification of the transducer	Data communication failed	Transfer the data from the station controller, see operator information m-Pro-400S ➔ Acknowledge the TS/TUS with <Reset>
	Data communication not completed yet	Transfer the data from the station controller, see operator information m-Pro-400S ➔ Acknowledge the TS/TUS with <Reset>

16 Maintenance / Service

Only trained personnel are permitted to perform maintenance. See service manual DGD-IS.

DANGER! High leakage current –
Fatal electric shock could occur!

- ➔ Always disconnect the power supply before performing maintenance work on the DGD-IS and the m-Pro-400S-CPM….
- ➔ Always disconnect the system cable, motor or motor cable from the m-Pro-400S-CPM… or DGD-IS before making throughput, resistance and short circuit measurements.
- ➔ Do not attempt to repair possible faults on the fastening system by yourself if you do not have the required knowledge! Inform the local repair center or your Sales & Service Center.
- ➔ Establish a grounding connection (PE) to the nutsetter control unit m-Pro-400S-CPM… before taking into operation!

WARNING!

High temperature –
the motor on the DGD-IS may heat up and cause burns during removal.
(max. engine temperature 90 °C). Wear gloves.

Regular maintenance reduces operating faults, repair costs and downtime. Implement a safety-related maintenance program that takes the local regulations for repair and maintenance for all operating phases of the tool into account.

17 Disposal

CAUTION!

Injuries and environmental damage from improper disposal.
Components of the DGD-IS pose risks to the health and the environment.

- ➔ The DGD-IS contains components that can be reused as well as components that require special disposal. Separate the components and dispose of them by segregating them clearly.
- ➔ Catch auxiliary materials (oils, greases) when drained and dispose of them properly.
- ➔ Separate the components of the packing and dispose of them by segregating them clearly.
- ➔ Follow the locally applicable regulations.

Observe generally valid disposal guidelines such as, in Germany, the Electrical and Electronic Equipment Act (ElektroG):

- ➔ Hand in the DGD-IS at your company collection point or return to Sales & Service Center.

Sales & Service Centers

Note: All locations may not service all products. Please contact the nearest Sales & Service Center for the appropriate facility to handle your service requirements.

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